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HUMAN PHYSIOLOGY.

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OF

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CORRIGENDA.

Page 67. line 1. of note, and
71. line 14. from bottom } for “Rastail,” read “Raspail.”
90. line 1. after “sheep,” add “horse, and dog.”
lines 4, 5. for “is neutral, or has only a little alkaline carbonate, and no sulpho-cyanic acid,” substitute “is acid, though it becomes alkaline while being collected, and contains salts of soda, potass, and lime, but no sulpho-cyanic acid.”
189. line 21. for “twin,” read “fœtus.”
line 22. for “fœtus,” read “twin.”
191. line 13. from bottom, for “head,” read “hand.”
220. last line, for “*chemical*,” read “*chirurgical.*”
234. line 7. from bottom, for “52°,” read “56°.”
523. line 5. from bottom, for “11,” read “224, sq.”
368.
369. } in note, passim, for “Dr. Dyer,” read “Dr. Dyce.”
375. line 5. from bottom, for “50,” read “56.”
383. note [1], first line, for “Mr. (now Lord) Jeffery,” read “Dr. John Gordon.”
389. line 2. of note, for “M. Retzius,” read “Baron Retzer.”
419. line 10. of note, for “XXI.” read “XXIII.”
424. line 1. of note *, for “*Phr.*” read “*Phil.*”
466. line 17. for “324,” read “304.”
497. line 8. from bottom, for “Sir G. Blane,” read “Whytt.”
509. last line, in a few copies, for “*ait*,” read “*fait.*”
667. line 10. for “George the Third,” read “George the First.”
719. line 16. for “iris,” read “irio.”
737. line 15. of note, for “herisson,” read “hedgehog.”
741. line 8. for “veins,” read “corpora cavernosa.”
813. line 4. for “John,” read “Joseph.”
889. line 12. from bottom, for “heart, which is the most permanent part,” read “head, which is the most permanent part (the heart).”

CHAP. XXVIII.

OF THE GENERAL DIFFERENCES OF THE SEXES.

THE functions which we have hitherto examined are for the existence and well-being of the individual. But, as he is destined to exist for a short time only, organs with other functions are established, the object of which is the production of other beings, like himself, to succeed him. These generative organs are not all supplied to the same system, but are divided between two; and the two systems, possessing together the complement of such organs, are brought into temporary contact and co-operation. The system with one set of organs is termed male, and the other female. The former excites the new being into development: the latter produces the germ, retains it within her, and nourishes it till it is launched into the world; and even then she nourishes it with a peculiar secretion, furnished by a pair of distinct organs termed breasts. To accomplish these purposes, two portions in each half of the brain are developed, endowed with two feelings, of which one propels the sexes to the union and excitement of their respective generative organs, the other is an ardent love of the offspring, and it, though necessary chiefly in the mother and therefore stronger in her, exists also in the father, since the love of the mother would be insufficient, as she, from being constantly occupied with nursing the young, could not fully procure subsistence, clothing, and lodging, and could not alone protect them, and advance them afterwards in the world. Every thing in the conformation and structure of each of the two sexes corresponds with these purposes. The male is formed for corporeal and intellectual power; the female for gentleness, affection, and delicacy of feeling.

> "For contemplation he, and valour, form'd;
> For softness she, and sweet attractive grace." [a]

Nature makes every thing answer many more than its fundamental purposes. The flowers and fruit of plants are fundamentally for the production of new beings. But the flowers serve to animals as objects of beauty to the sight, of pleasure to the smell and to the taste, and as nourishment; the fruit serves as materials of nourishment to an infinity of animals; and infinitely more of both flowers and fruit is produced, and serves these secondary purposes, than ever comes to answer the fundamental purpose of the production of a new individual. The whole arrangement of agencies throughout the world appears to be analogous to this. In the case before us, the sexual qualities of the two sexes are made to answer far more than the mere production, development, and support of new individuals: a great amount of pleasure is secured to each in the contemplation and society of the other, and the act of generation is the summit of their enjoyment of sensation. The love of the offspring is another source of endless delight. The highest degree of friendship or permanent attachment is the ordinary joint result of the sexual propensity and the continual association of two beings of opposite sexes; and thus still more pleasure is secured. To support and protect the female and the offspring becomes a great source of the intellectual and corporeal exertions of the male; and the principal excitement to activity in the female is to administer to her children and prepare comforts for her husband on his return from his labours and the annoyances of the world.

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[a] *Paradise Lost*, b. iv. 297.

The man's immediate share in generation is short and occasional; the woman's long and almost constant. She begins the production of germs before impregnation; she remains pregnant a long period; she goes through the process of parturition; and then suckles for a length of time; so that a far longer portion of her destiny than that of man is for the preservation of the species. Love has been said by Madame de Staël to form her history; while it is but an episode in the life of a man. We of the other sex should delight in seeing the intellect and taste of women cultivated to the utmost of their capabilities; but it is clear that woman is not intended for the rough business of the *world*, and that her perfection is best displayed in quiet intellectual and elegant occupations, and in care and activity directed to the happiness of those individuals to whom she is attached.

> "For nothing lovelier can be found
> In woman, than to study household good,
> And good works in her husband to promote." [b]

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[b] *Parad. Lost*, b. ix. 232.

Women ill appreciate the true loveliness of their sex who wish to resemble man in their mind and occupations.

> "All higher knowledge in her presence falls
> Degraded: Wisdom in discourse with her
> Loses discountenanced, and like Folly shows."[c]

The whole mental and corporeal structure of the two sexes is affected by and is in conformity with the respective procreative and parental duties of each.[d] The organs of generation and all the parts connected with them are far larger in the female than in the male, thus harmonising with the greater share that woman is destined to take in the continuation of the species.

"In general, each sex has its peculiar *form;* more or less striking after birth, but not very obvious in the young fœtus; for the genitals of the male and female, at this period, are not at first sight different, on account of the clitoris being remarkably large[e], and the scrotum scarcely formed.[f]

"During infancy, the general figure is but little different, but it becomes more so as age advances, when the round and plump breasts, the general conformation, the delicacy, softness, and the proportionally low stature of the female," who is one sixth shorter, "form a striking contrast with the sinewy and robust body of the male."[g]

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[c] *Parad. Lost,* b. viii. 551.

[d] "Melch. Sebiz, *De differentiis corporis virilis et muliebris.* Argent. 1629. 4to.

F. Thierry, *E. præter genitalia sexus inter se discrepant.* Paris. 1750. 4to.

Dictionn. Encycloped. (Yverdon edit.) vol. xviii. art. Femme, and vol. xlii. art. Viril.

J. Fidel Ackermann, *De discrimine sexuum præter genitalia.* Mogunt. 1788. 8vo.

The same writer's *Historia et ichnographia infantis androgyni.* Jen. 1805. fol. p. 61. sq.

P. Roussel, *Système physique et moral de la Femme.* 2d edit. Paris. 1803. 8vo.

Ad. F. Nolte, *Dissertat. sistens momenta quædam circa sexus differentiam.* Gotting. 1788. 8vo.

J. Louis Moreau de la Sarthe, *Histoire naturelle de la Femme.* Paris. 1802. 3 vols. 8vo.

Autenreith, *Archiv. für die Physiol.* t. vii. p. 3. sq."

[e] "Langguth, *Embryo* $3\frac{1}{2}$ *mensium qua faciem externam.* Viteb. 1751. 4to.

James Parsons, *Phil. Trans.* vol. xlvii. p. 143.

Morgagni, *De sedibus et causis morborum.* xlviii. 10."

[f] "This I lately found confirmed in twin abortions of different sexes and of about sixteen weeks' formation, in which, although they were most beautifully and correctly made, the difference of the genitals was not at first discoverable. In every other respect, — in the general figure, physiognomy, the dimensions of the loins, &c., they were perfectly similar."

Her face and brain are absolutely smaller than those of man, the face likewise proportionally so; yet such is the relative size of the cranium, that, while in the male the head, including the teeth, is as 1 to 8 or 10, in the female it is as 1 to 6, of the weight of the rest of the skeleton.

Her form is more delicate: her surface has no muscular protuberances, but is beautifully rounded; her legs, therefore, have no calves, but, like the arms and fingers, gently taper; her feet and hands are small; her neck longer, and without projection. From her smaller stature and the greater length of her abdominal and lumbar regions, it follows that the middle point, which lies at the pubes in the male, is situated higher in the female. Her abdomen is more prominent and rounded: the line drawn from the centre of the sternum to the pubes is parallel with the axis of the body in woman, but converges towards the axis in man. "Her hips are broader, not, however, if well formed, broader than the shoulders; her buttocks larger"; and these and the hips fatter.[h] The abdomen and pelvis receive a larger quantity of blood then in the male, the descending aorta and iliacs being larger and of less thickness, the former augmenting more as it descends, and the latter dividing into more branches. The nerves of the pelvic plexus are nearly as large again in woman as in man; and the branches of both mesenteric plexuses to the genitals also much more voluminous. Her thighs are more voluminous and distant from each other, and "in their descent gradually approach each other towards the knees," whence she finds a difficulty, and waddles if she attempts rapid walking or running; the only movements she executes without grace, as Rousseau remarks. The difficulty of quick progression agrees with her destiny of being pursued and overtaken by the other sex. The greater capacity of the female pelvis, for containing the chief organs of generation and affording a passage to the child, arises from the greater expansion of the ossa ilei, the larger angle of the junction of the ossa pubis, and the greater concavity and breadth of the os sacrum: the os coccygis likewise is more slender and moveable. Her shoulders stand less forward and distant from the trunk. Her clavicles are less bent; the thorax more projecting, whence deeper, although narrower and shorter; the sternum shorter and broader; the cartilago ensiformis shorter; the two superior ribs flatter, and her chest "is more moveable above." Camper remarks that, if the male and female forms are traced within two ellipses of equal dimensions, the male shoulders will stand without and the pelvis within, while the female shoulders will remain within and the pelvis without.[i] Her lungs are consequently smaller. The absence of the projection in front of the neck, so remarkable in the male, arises from her larynx being more contracted and scarcely prominent: whence, too, her voice is less grave. The os hyoides also is much smaller.

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[g] "Consult, besides our great countryman Alb. Dürer, *Vier Bücher von menschlicher Proportion.* Nurenb. 1528. fol. the two celebrated male and female figures, painted by Titian, or one of his school, in Vesalius's *Epitome suor. libror. d. c. h. anatome.* Basil. 1542. fol.

Also the three delineated by that excellent artist, Jer. Laidresse, in Bidloo, tab. i, ii, iii.

And Girardet's figures in the *Cours complet d'Anatomie gravé par* A. E. Gautier, *et expliqué par* M. Jadelot. Nantes. 1773. large fol."

[h] Among the Boshmans of the Cape of Good Hope, — people at the bottom of the human scale, the fat actually forms a large cushion, on which these women are generally resting, and which trembles like jelly as they walk. One of them, termed the Hottentot Venus, died at Paris, and an enormous mass of very soft fat was found under the muscles. Some monkeys, the Papios and and Mandrells, have masses of fat in their bare buttocks.

The heart is smaller, and the coats of the arteries proportionately thinner than those of the veins, in the female. Her blood is said by Lecanu to contain more water and albumen, and less fibrine and red particles, than the blood of man. Her whole system is softer and more watery, and she is less prone to diseases of induration. Even male diœcious plants are drier than the female.

"The hair of her head is commonly longer: but other parts, which are covered with hair in men, are either quite smooth in women, as the chest and face[k]; or less hairy, as the perinæum; or smaller in circumference, as the pudenda; or covered with merely a very delicate and soft down, as the arms and legs."[1] In men the hair frequently ascends in the centre from the pubes to the navel; but very rarely, if ever, in women.

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[i] *Mémoire sur le beau Physique.*

[k] It cannot but be a custom most insulting to nature to shave off the beard, which, if kept in proper trim, as birds and beasts instinctively keep their plumage and hair in good order, completes the perfection of man's face and the external distinction of the sexes, and, whatever ladies pretend to the contrary, renders him far more attractive to women, at any rate when custom has had time to lessen their seeming repugnance; for their preference to men with good whiskers is

"The female skin is more delicate, and of a clearer white," and the more so "from the larger quantity of fat beneath it."

"Her cellular membrane is more lax and yielding, so as to dilate more easily during pregnancy."

"The muscular system is weaker, and the muscles (with the exception of the glutei, psoæ, quadrati lumborum, and a few others) proportionally smaller."

"The bones are, cæteris paribus, smoother and rounder, the cylindrical more slender, and the flat thinner; to pass over individual differences, *v. c.* the very slight prominence of the frontal sinuses, the more elliptic edges of the alveoli, &c."[m]

The whole female system is more excitable, though less enduring. "The pulse is, cæteris paribus, more frequent," and more easily quickened; the brain more liable to sudden emotion, which, however, is shorter: "the growth of the body more rapid; and

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certain. Shaving was forbidden by Moses, and therefore, according to Jews and Christians, by God: it was a severe punishment among the Indians, and an irreparable insult among the Germans. The Osmanli swears by his beard, and spends half his day upon it. Shaving prevails in Europe because the kings of France set the example to their courtiers, who were followed by the nation, which formerly gave the ton to neighbouring nations and therefore was at length followed by all in this troublesome and unmanly fashion. (*Burdach*, § 18.)

[1] An instance is related by M. Roux of a woman forty years of age, who had one child, and whose breasts were well developed, having a strong and long beard: the lobes of her ears were also covered with hair. (*Anatomie descriptive*, par Xav. Bichat, t. v.)

It is remarkable that, while the human female is so divinely beautiful in every point, hen birds are often an absolute contrast to the cock, from having far less beautiful and copious plumage, and smaller and less beautiful combs, and little or no beauty and power of voice. Many male fish are more beautiful than the female. But the skin and its appendages, hair, nails, horns, claws, &c., are greater generally in male animals than in the female: and the odorous secretions of the skin and various parts connected with it in men and male brutes are more abundant and powerful.

[m] "I have described these differences more fully throughout the skeleton, in my *Osteological work*, p. 87. sq. 2d edit.

Compare Sömmerring's *Tabula sceleti fœminei*. Francof. 1796. fol. with the male figure in B. S. Albinus's *Tabulæ sceleti*, tab. 1."

the periods of dentition, puberty, and full growth earlier." Her body is less capable of long exertion; her "appetite for food, and her stomach are less."[n]

Greatly inferior to man in reasoning powers, extent of views, originality and grandeur of conception, as well as in corporeal strength, woman possesses more acuteness of external sensation, of apprehension, and of emotion, though a smaller range of intelligence and less permanence of impression, more tenderness, affection, and compassion, more of all that is endearing and capable of soothing human woes; but less consistency, impetuosity, courage, and firmness of character, except where affection subsists. She is more disposed to believe all things, and to confide in all persons; to adopt the opinions and habits of others; has no originality, but follows and imitates man; and she cannot live happily without attachments, and these are sincere and lasting, even when deserved no longer; though, from her variability of emotion, she often quarrels temporarily with those she loves the most;—*Varium et mutabile semper fœmina*, from the rapid change of her emotions, is a true character; but nothing is too irksome, too painful, or too perilous, for a mother, a wife, or a mistress, to endure or attempt for the object of her love.

> "A thousand acts in every age will prove
> Women are valiant in a cause they love.
> If fate the favour'd swain in danger place,
> They heed not danger,—perils they embrace,
> They dare the world's contempt—they brave their name's disgrace.
> They on the ocean meet its wild alarms,
> They search the dungeon with extended arms,
> The utmost trial of their faith they prove,
> And yield the lover to assert their love."[o]

Woman is remarkable for the delicacy of her taste, her quickness of apprehension of things within her reach of intellect, her insight into character, and tact.[p]

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[n] "Hence genuine and indubitable cases of long abstinence from food have generally occurred in females. See, among many others, Fl. James Voltelen, *Diatr. memorabilem septennis apositiæ historiam exhibens.* Lugd. Bat. 1777. 8vo." And beastly gluttons have generally been men.

[o] Crabbe, *Tales of the Hall*, xxi.

[p] Thus, though few women can take grand political views and be political philosophers, they are probably more fitted for the business of government than men. "Politics," says Burdach, "are not above the reach of women. Indeed, there have been many able and excellent queens. It may, indeed, be a question

Woman, without reflection, but intuitively, not only seizes the character of things within her power more clearly and quickly, but the future also; so that in exalted conditions of the mind she predicts the best, and she has greater presence of mind. All in her is exquisite apprehension and conception, not force and reasoning. What man accomplishes by force, she effects by stratagem or management.[q] Being timid, credulous, and deferential, she is the slave of fashion and custom, and of those habits and opinions in which she has been brought up, or which she hears most praised by those around her.

She has more capability of endurance of bodily and mental anguish, though her emotions, like those of children, are rapid, and from slight causes; and like them she passes in a moment from gaiety to grief, and in her distress sheds tears, which are extracted from man only in the deepest sorrow. Man is proud of his force, intellectual, corporeal, and even sensual: woman is retiring, unambitious of power, but vain of beauty and little acquirements. Her love of offspring is far stronger, and her sexual desire far less: she is also far more modest in sexual points, — a circumstance agreeing with the fact of her genitals being internal and concealed, while man's are external and visible.

The head of the female is as different from that of the male as her mental character. It is altogether smaller. The forehead is smooth, from its various parts being equally developed; full above the nose; narrower, but of only moderate height, and gently retreating: the inferior parts of the sides and occiput are small (sexual desire, instinct to take away life, courage); but the development immediately above is proportionally considerable (attachment, cunning); the summit of the head is proportionally high (veneration).[r] The development of the respective parts of the brain is in precise conformity with that of the cranium. The contrast of the small cerebellum with the long posterior lobes of the cerebrum is very striking.

Her organs of every external sense are smaller, and their

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whether, taking equal numbers, we should not find the advantage on the side of women." (l. c. § 196.)

[q] The females of dogs are more sagacious in field sports than males; and the female fox and hamster more wary. (*Burdach.*)

[r] See a delightful paper upon the female character by Mr. W. Scott, in the *Phrenological Journal*, No. vi. art. 17.

sensibility, like that and the excitability of her whole frame, more exquisite, though their range of appreciation is smaller, from the smaller size of all, and from peculiarities in the eye and ear.

Sir Everard Home suggests[s], or more probably he found that John Hunter suggested, that the sex is not determined at the first formation of the individual, but that the parts of generation are originally so situated, and of such a nature, that they are capable of becoming either male or female organs when the sex is subsequently fixed.[t] His arguments are the following: — 1. The testes and ovaria lie originally in the same situation. 2. The clitoris is at first of great size. 3. When the female among brute mammalia has inguinal mammæ, so likewise has the male; men also possess breasts. 4. The scrotum occupies in the male the place occupied in the female by the labia, and is of the same structure with them. 5. The nymphæ of the female exactly correspond to the preputium of the male. 6. Twins are usually of the same sex, as if the same cause had influenced the generative organs of each; when they are of different sexes, it is a common remark that one of them often does not breed, nature probably having been disturbed in her operations. 7. When among black cattle twins are produced of different sexes, that which appears the cow is really an imperfect hermaphrodite, possessing a mixture of incomplete male and female organs; sometimes, for instance, having testicles in the place of ovaria, sometimes four substances, looking like testes and ovaria, is generally[u] incapable of breeding, and vulgarly termed a free martin; — a circumstance in every respect analogous to the preceding.[v] It may be added that the round ligaments of the female descend, like the two spermatic chords of the male, to the abdominal ring; that marsupial bones exist, without any function whatever, in the males of some marsupial animals; that the hen has a bursa Fabricii; and that the glans clitoridis of the female opossum is bifid. Comparative anatomy furnishes many similar facts. The existence in both sexes of parts which can be useful only in one was confessed by Paley to have been a complete puzzle to him[w]: even some *species* of animals have various parts that are useful only in other species. These are all equally examples of nature's observance of general laws. Every animal is made more or less on the same plan. Some parts are greatly developed, some little, some not at all, so that they do not exist, and some have probably not had the germ of existence. In their development they are variously modified; so that what is a hand and arm in one, is a wing in another, and a fin in another. It is the same with even portions of parts as with parts. The facts mentioned by Sir E. Home, therefore, do not show that the sexual organs are the same originally, or different originally, more than other parts are originally the same or different in different species of animals.

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[s] *Phil. Trans.* vol. lxxxix.

[t] The opinion prevailed among the Greek and Arabian physicians (Galen, Avicenna, Ægineta, Rhases), who asserted that the male and female organs differed in situation only, that the structure was originally the same, but that, when the constitution had a good degree of heat, the parts protruded, and a male was formed; whereas, when the temperature was low, they were not excited, and remained within, giving the female sex. Swift makes Martinus Scriblerus, in his *Annus Mirabilis*, Dec. 29. 1722, render his prophecy of the mutual transformation of the sexes probable. Because, 1. It was an ancient doctrine of philosophy that Adam was an hermaphrodite, and had no female mate till he lost his innocence by a *faux pas*: 2. Two transformations have occurred, one well attested by Montaigne, and another by the late Bishop of Salisbury. 3. "Every smatterer in anatomy knows that a woman is but an introverted man; a new fusion and flatus will turn the hollow bottom of a bottle into a convexity; but I forbear for the sake of my modest men readers, who are in a few days to be virgins."

[u] It is said to be sometimes very prolific.

Mr. Knight considers that the sex of the offspring is determined by the female rather than by the male. He observed that individual cows, &c., however various the males, produce one sex rather than the other, so that he has with tolerable certainty predicted the number of male and female young; while nothing similar was ever observable in regard to his bulls, rams, &c. Even the external appearance and the habits of brutes and vegetables, he has found much more, and sometimes altogether, influenced by the female. The quantity of pollen employed in the fecundation of female plants, he found of no importance in this respect.[x]

But M. Girou de Busareingues, from repeated and extensive experiments, ascertained that, whatever may be the influence of particular individuals, the age of the male, among sheep and horses, has a very great general influence upon the sex. The younger the males, the greater the number of females produced, and *v. v.* The better also the mothers were fed, the greater the number of females and twin births.[y] The stronger also the mother, and the more in her prime, the greater the number of females; the weaker from any cause, or if she was below or beyond her prime, the more males were produced. This was noticed also among cows. Now, as the germ is furnished by the mother before sexual intercourse, the dependence of the sex of the new being upon the father shows that the sexual organs are, as Sir E. Home, or probably John Hunter, suggested, the same originally.

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[v] J. Hunter, *Observations on Certain Parts of the Animal Economy*, p. 55.

[w] *Natural Theology*, c. 25. p. 472.

[x] *Phil. Trans.* vol. xcix.

[y] *Journal de Physiologie*, t. vii.

Hermaphroditism is the existence of organs of both sexes in the same individual. They may merely coexist without union, or they may be more or less united. The former kind of hermaphroditism prevails naturally in the majority of plants, and especially in the most perfect, the dicotyledons; it is seen among the entozoa, annelida, and mollusca. In the latter kind, the orifices of the organs may open into a common cavity, as in most planaria and some mollusca; may unite into one duct, as in some mollusca; or the canal of one genital organ may penetrate into the other genital organ, so that the organs are more or less mingled or fused, as in some mollusca, — in the pleuro-branchæa, for instance, the oviduct divides into two branches, one of which runs to the external genitals, the other to the testes and external male organs: in the Clio borealis among Pteropoda, and in the Doris and Tritonia among Nudibranchia, the oviduct runs altogether to the testes; in the Planorbis corneus, Limax ater, and Helix, among mollusca with lungs; and in the distoma perlatum, of Nematodes, and in the earth-worm. Natural hermaphroditism is not known to occur among vertebrate animals.

Distinction of sex begins to appear among plants in the class Polygamia only; and in it the plant has even hermaphrodite as well as male and female flowers. In the class Diœcia, the distinction is greater, — the male and female flowers are each on separate plants: but there are no general differences in all the particulars of the form and function of the plants themselves: hermaphrodite flowers also are frequently seen on them; many are monocotyledonous, and none marked by the highest vegetable organisation. Sexual distinction is slightly and incompletely developed among the lowest animals, — among entozoa and mollusca; becomes permanent in insects, arachnida, crustacea, and the vertebrata; and is most complete in man.

Monstrous hermaphroditism is not uncommon in inferior animals, for instance, moths, eels, carp, crabs, each half of the body possessing the characteristics of a different sex; and is the least uncommon in osseous fish: but far more common than in any animal, among Diœcia, male flowers being frequently seen on the female plants of Urtica dioica, Spinacia oleracea, &c. There probably exists no authentic account of a true hermaphrodite[z], capable of impregnating and being impregnated, among mammalia. Yet, occasionally, brutes of this class have perfect organs of one sex, combined with imperfect ones of the

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[z] Hermaphroditus was the son of Mercury and Venus, — Hermes and Aphrodite, who, while bathing in a fountain of Caria, smote the heart of its presiding nymph, Salmacis. He rejected her entreaties, and she, endeavouring to obtain her wishes by force, closely embraced him, and implored the gods to make them one body; her prayers were heard, and the characteristics of each sex were preserved.

> Mercurio puerum diva Cithereide natum,
> Naiades Idæis enutrivere sub antris;
> Cujus erat facies, in qua materque paterque
> Cognosci possent: nomen quoque traxit ab illis.
>
> Ovid, *Metam.* iv. 288.

Formerly, the existence of true hermaphrodites was not doubted. In Winrich (*De ortu monst.* c.20.), Riolan (*De hermaphr.* c.8.), and Shenkius (*Obs.Med.*575.), we read of a maid servant who, in 1461, was condemned to be buried alive for having got her master's daughter with child. Montuus declares that he knew an hermaphrodite, supposed to be a female, who had brought her husband several children, and was in the habit also of intriguing with females. Sanchez, the celebrated Jesuit casuist of Cordova in the 17th century (*Disput. de sancti Matrimonii Sacramento*, cvi.), determines that an hermaphrodite should adopt the predominant sex, or, in case of equality, choose one and adhere to it, nor be allowed to marry till this is done. The Jewish and Canon law treat of hermaphrodites, and Lord Coke says (lib. 1. § 1. fol. 8. of fee simple), every heir is male, female, or hermaphrodite, *i.e.* both male and female, and "an hermaphrodite, which is also called an androgynus, shall be heir as male or female, according to the kind of sex which doth prevail, and accordingly ought to be baptized." The ancients thought them ill omens (Cicero, *De divinatione*), and drowned them. Eusebius says that the Christian emperor, Constantine, once ordered them for destruction, because the Nile did not overflow so much as usual. For much learned information, see Dr. Parsons *On Hermaphrodites.*

When there is no combination of the organs of both sexes, a little variety has frequently given rise to a mistake in the sex. If the septum of the scrotum is narrow, each half may so closely surround the testis as to give an appearance of labia. If, at the same time, the urethra terminates before it reaches the extremity of the penis, and especially if the testes are ill developed,—a circumstance very common in this malformation, the feminine appearance is much augmented.

As smallness of the testes is often accompanied by want of the constitutional male characters,—beard, prominent larynx, grave voice, and broad shoulders, and in these circumstances the female character of broad hips, breasts, &c., more or less appears, a superficial observer may easily mistake the sex of such persons. A deficient development, or total absence, of the testes, may be attended by all these general effects, without malformation of the scrotum or urethra. The malformation of the scrotum just mentioned, together with smallness of the penis, has sometimes occasioned a mistake of the sex till the period of puberty, when the true sex has become evident, and the individual been imagined to have changed his sex. Ambrose Paré mentions a Marie Germain, who had been always thought a girl; but, while she was leaping over a ditch one day at puberty, a penis suddenly disclosed itself and proved her to be a lad. Montaigne also mentions him (*Essais*, l. 20.), and another to whom the same fortune happened while playing in bed with a female. Livy and Shenkius have recorded many such. In the *Journal de Méd. Chir. et Pharm.* 1816, a young man is said to have passed for a female all his life, and was on the point of marrying with another young man, when his parents, being aware of something wrong in his construction, and that he had never menstruated, determined on a previous medical examination. The doctors pronounced him (Mary) a male; he instantly burst into tears (so much had friendship all along taken the place of love), and exclaimed, that then she should lose her *bon ami*. His dress and register were changed by order of the authorities, and he was very nearly made a soldier.

On the other hand, with a bulky clitoris, which is common in the Mandingo and Ibbo nations, especially if accompanied by coherent labia, or by no labia, an opening at the same time existing under it and leading to the urethra and vagina, a female may be carelessly mistaken for a male: but the clitoris is imperforate, and has no preputium at the lower part, and, consequently, no frænum; and a probe passes at once into the bladder, whereas in ambiguous males, it may have far to go. Dr. Baillie (*Morb. Anat.*) considers this as distinctive of the individual being a male: but I have seen the urethra in an ambiguous male, with a narrow scrotal septum giving the appearance of labia, cease to be more than a groove after running a certain way from the bladder, so that a probe introduced into it presently reached the bladder.

We thus see the origin of the stories in Virgil and Ovid of Cœneus (*Æneis*, VI.), and Scytha (*Metam.* II.), whom Ausonius Gallus, from his own case, knew to be quite unnecessary to establish the fact:

Nolo tamen veteris documenta accersere famæ;
Ecce Ego sum factus fœmina de puero.

Zacchias, *Quæst. Med. Leg.* p. 496.

On a person so metamorphosed, Bauhin made the verse—

Mas, mulier, monachus, mundi mirabile monstrum.

other[a]; and both they and the human subject each set imperfect, so as to be, though in various proportion to each other in different cases, *neutrumque et utrumque.*[b]

> " Concretus sexu non perfectus utroque
> Ambiguo venere, neutro potiundus amore."

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[a] In the *Phil. Trans.* 1799, Sir Everard Home describes a bull which had begot five calves, and possessed ordinary male organs, and had the general appearance of the male, except in the flanks and hind quarters, but which had an udder and teats affording milk, and a small vagina, incapable of admitting the male organ.

[b] See a human instance in Dr. Baillie's *Morbid Anatomy*. The general aspect was masculine, except that no beard existed. There were breasts, a clitoris, and meatus urinarius of the natural female appearance; but a vagina only two inches long, and terminating blindly, and no nymphæ; labia very long, and each containing a body feeling like a testicle. Menstruation had not occurred. In the *Medical Repository* an adult is said to be described of general masculine aspect, having in the left groin a small scrotum containing a testicle, and on the other side a labium; a vagina and hymen, or at least a small opening, existed, and the urethra resembled the female; but the clitoris was 2½ inches long, when not erect, and had a groove below as if for a male urethra: menstruation had not occurred, nor sexual desires been experienced.

M. Petit (*Mém. de l'Acad. des Sciences*, 1729, p. 29.) has described the generative organs of a soldier, who died of his wounds. The penis is not mentioned, and therefore probably was normal, but the scrotum was destitute of testes, and there was a blind vagina communicating with the urethra. Two testes were discovered in the usual situation of the ovaria, possessing vasa deferentia, which passed as usual to vesiculæ seminales. There was also a prostate gland. This person might have performed the part of a male bedfellow, but unfruitfully, from the termination of the urethra in the vagina, unless such means could be successfully employed as are mentioned in John Hunter's *Treatise on the Venereal Disease.*

Analogous cases of spurious hermaphrodism among brutes are the free martins of black cattle already mentioned (p. 707.). In two, John Hunter found imperfect testes in the situation of the ovaria, and in a third were both testes and ovaria lying together. In an hermaphrodite ass he also discovered substances resembling both testes and ovaria. Sir Everard Home has described a similar dog, which had long been a favourite in Lord Besborough's family, and had never been in heat. " There was not the smallest appearance of teats on the skin of the belly; so that in this particular it differed both from the male and female; nor was there the least trace of any thing like the gland of the breast under the skin. The clitoris was very large, being one third of an inch long, and one half of an inch broad; the orifice of the meatus urinarius was uncommonly large, as if it was intended for a common passage to the bladder and vagina, so that the external parts were only the clitoris, meatus urinarius, and rectum. Internally, Nor that in such combinations in the human subject one testis and ovarium now and then exist, do I at all doubt, after reading the case given by Maret[c], and seeing the creature shown here under the name of Lefort.[d] In the former, a testicle on one side and an ovarium on the other are decidedly said to have existed, besides vesiculæ seminales, a Fallopian tube, an uterus, a blind vagina, and a blind penis: from the middle upwards the general characteristics of the female were conspicuous, and from the middle downwards those of the male. The person died at twenty-seven years of age. Lefort had the general characteristics of each sex. The relative proportion of the trunk and extremities, that of the shoulders and pelvis, and the conformation and dimensions of the latter, were those of the male; the chin had as good a beard, and the chest and extremities were covered with as abundant hair, as we usually observe in fair young men of the same age. Yet there were beautifully formed breasts, with perfect areolæ and nipples, the hands and feet were small, and, like the other portions of the extremities, most elegantly tapering. Its unforeseen departure from London deprived me of the advantage of a second interview; but I thought that the voice, face, cranium, and mental character were a mixture of those of both sexes. I could not have said, on seeing such a face only, whether it belonged to a man or a woman.

"——— forma duplex, nec fæmina dici
Nec puer ut possit; neutrumque et utrumque videtur!"[e]

The eyes certainly sparkled with desire. Now, had this been a

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in the situation of the ovaria, were two imperfectly formed small testicles, distinguished to be such by the convolution of the spermatic artery; from these passed down an impervious cord, or vas deferens, not thicker than a thread, to the posterior part of the bladder, where they united into one substance, which was nearly two inches long, and terminated behind the meatus urinarius. The other parts of the animal were naturally formed. When the testicles were cut into they appeared to have no regular glandular structure." (*Phil. Trans.* 1799.)

Haller describes a very similar kid: the imperfect testes were in the same situation. There was likewise a canal or vagina, which divided like the uterus into two horns, extending to the testes. There were also vesiculæ seminales.

[c] *Mém. de l'Acad. de Dijon*, t. ii. See also a remarkable case in the *New York Medical Repository*, vol. xii. p. 86.

[d] See also a dissection in the *Dictionnaire des Sciences Médicales;* and one by Schnell, quoted by Meckel in Reil's *Archives für die Physiologie*, t. xi. p. 328.

[e] Ovid. *Metam.* iv. 378.

man with imperfect organs, there might indeed have been the characteristics of the female more or less marked, but certainly not those of the male; and vice versa. On this account I am disposed to believe it was in possession of at least one testis and one ovarium. The best judges in Paris pronounced it to be a woman; the best in London, a man. With respect to the genitals, being young at the time, I own myself to have been disinclined to examine them at a first interview, but learn there was a small clitoris — with an imperforate gland, and an urethra running along it inferiorly (a structure perhaps unknown in monstrous formation of simply female organs), and opening underneath by five small holes.[f] A passage existed at the foot of the clitoris, into which a catheter passed, but which afforded no urine. The catheter introduced into it might be directed downwards behind a membrane that united the labia below, where the opening of the vagina is commonly found, and would probably have been divided with advantage, as the menses came through this passage. In fact, both they and the urine passed through it and the five holes of the canal that was under the clitoris, and the urine is reported to come through both, although the catheter could bring none, and neither passed into the bladder, nor excited a desire to make water, if introduced into the lower canal. Whence there is probability in the conjecture, that the urethra communicated with this passage within, by similar openings to those observed externally in its lower part.

Lefort was seen to menstruate, and those who did not inspect the pudenda when visiting it at this period, declared the countenance to be pale and languid as in a menstruating woman. It boasted of having menstruated ever since eight years of age, of having desires for each sex, and of being able fully to enjoy both. But a little exaggeration of this kind must be expected. The attendant told me that it had kept a young French girl some years. Whether seminal discharge took place is doubtful, as the communication between the testes (if there were any) and urethra might be deficient in some point. That it could derive any pleasure from sleeping with a male, except in the general contact, was impossible. On the contrary, the membrane that united the labia must have prevented coition, and rendered every approach of the male organ extremely painful. No wonder, therefore, that, though its habits were feminine (it did needle-work), perhaps, in some measure, from confinement, it had chosen a girl for its associate. Independently, however, of these circumstances, I do not suppose that Lefort's beard and hairiness of breast and limbs would easily procure a *cavalier servente.*

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[f] *Dictionnaire des Sciences Médicales*, art. HERMAPHRODISME.

The degrees of apparent and real monstrous hermaphroditism have been classed thus by Burdach : —

i. In the external organs only. 1. Gynandry; a penis without urethra, or with a mere groove; or a blind cavity, formed by division of the perinæum or scrotum; or the continuance of the testes within, or the development of the mons veneris or of the breasts. 2. Androgyny; a clitoris with an urethra; or a vagina opening into the urethra; extreme smallness of the vagina, or extreme largeness of the clitoris.

ii. In the median organs only. 1. Gynandry; Testicles, but the vesiculæ seminales transformed to an uterus. 2. Androgyny; the ovaries united with vasa deferentia and vesiculæ seminales.

iii. The internal organs. An ovary on one side, and a testis on the other, in their natural situation or in another; or two testes and two ovaries.

Life is supposed by some never to occur spontaneously in matter, but always to be propagated from an organised system already and still endowed with it. They urge that no instance has been known of a plant or animal of any species, whose mode of multiplication may be always easily examined, springing up spontaneously; and that, although in many other cases the origin often cannot be discovered, our inability to discover the mode of propagation does not justify us in denying its existence; but that the general analogy, the discovery of the modes in which many species propagate which were adduced by Aristotle and other ancients and the older moderns as instances of spontaneous generation[g], the generation of oviparous or viviparous animals, actually observable in some species whose existence in their particular residence is inexplicable (as of certain *entozoa,* — animals bred and living in others, found in the cellular texture [h]), and the occasionally manifest source of the difficulties which obstruct our inquiries, lead necessarily to the belief, not of the unreality of the fact, but of our deficient penetration to discover their germs. Yet many eminent writers, and among them Lamarck, Tiedemann, Burdach, believe in equivocal or spontaneous generation, or, to use Burdach's expression, *heterogenesis* or the production of a being different from that which, together with the co-operation of other circumstances, gives rise to it, in distinction from *homogenesis* or the production of a being from one like it.

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[g] Dr. Ehrenberg has proved the animalcules termed rotifera to be oviparous,— discharging eggs the 12,000th of an inch in diameter; viviparous, — containing young ones in motion; and gemmiparous,—producing buds on their sides which are cast off when developed enough to provide for themselves.

[h] Cuvier, *Règne Animal,* t. iv. p. 2. In the disease of wheat, called the purples, Mr. Bauer discovered innumerable animalcules in the seed. Their presence ap-

They argue (Burdach, § 7.) that our planet, like every thing in the universe, great or small, has arrived at its present condition by degrees; that, at a very remote period, it was unfit for the habitation of living beings; that these, as it became in its progressive changes more and more favourable to their existence, were formed gradually upon it without predecessors; and that, as it remains favourable to their existence, it still possesses the same power, which cannot be transitory, but must be inherent in nature, and must always become efficient under favourable circumstances; so that, although this productive power is at present exerted only in the way of propagation and preservation (for the generative, nutritive, and reparative processes are all fundamentally the same) in regard to superior beings, it still gives rise to inferior forms from heterogeneous elements; just as, although superior organs or viscera, when destroyed, cannot be restored, inferior structures, as cellular membrane, capillary vessels, and bones, may be replaced.

The facts adduced (Ibid. § 8. sqq.) are, that, after water has been poured upon certain substances, microscopic and vegetable animals appear which, or even the germs of which, previously did not exist. These are properly called infusoria, although the name is given to microscopic vegetables and animals in general. The substances with which the water is mixed is most productive when coherent, but may be a wet mass of various consistence, and it may, if organic, be, 1. Decayed living systems or their parts. Those which decompose most readily in air and water usually produce infusoria the most abundantly; and those which do not decompose in humidity, as camphor, tannin, pure sugar, give rise to none: dead infusoria produce them like other dead organisations. 2. The proximate principles of organised systems; — albumen, gelatine, &c. 3. Substances which, though changed from their original nature in organised systems, are susceptible of further change, as sour beer, bad vinegar; and the substance must be decomposing at the points where the infusoria are produced. 4. Gruithuisen declares that pure water poured upon granite, anthracite, or marble, produces them; notwithstanding it will not if poured upon glass, iron, copper, lead, potass, or sea salt. Treviranus produced none from water poured upon mercury; but detected them in water containing culinary salt or saltpetre.

Infusoria appear most abundantly if the water is fresh dew, employed to

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peared inexplicable, yet he found them multiply by viviparous generation. But the difficulty was solved by placing a quantity of them in the depression at the back of a healthy seed, and sowing this; when he found the stem of the new plant filled with them. *Phil. Trans.* 1823.

prepare infusions; next in rain or fresh spring water; in water kept in close vessels, and whose infusoria produced from itself have all perished; and least abundantly in boiled and distilled water, though this will produce them as copiously as fresh water, if the solid substance is favourable to their production. Atmospheric air is necessary; and air powerfully contributes to their formation; but hydrogen or azote are substitutes for it. The character of the infusoria will vary according to either the solid substance, the water, or the air; nay, according to the state of cohesion in which the solid is employed. A smaller proportion of water is required for the production of vegetable than of animal infusoria. Both are more abundant if the air has access not only to the water, but to the solid. Too high a column of water above the solid has occasioned motionless globules to appear instead of distinct animalcules. Temperature, light, electricity, and season affect their formation. Burdach, in conjunction with Hensche and Baer, boiled some fresh inodorous earth, destitute of foreign matter, in water for a long time; evaporated the fluid to a thick extract; and put this into recently distilled water and oxygen or hydrogen, in bottles closed with emery and a bladder; when Priestley's green vegetable substance appeared, and, if common water and atmospheric air were employed, animalcules were produced. If marble with distilled water and oxygen or hydrogen was used, a mucilaginous substance with white ramifying filaments appeared; and if a piece of granite, green matter with confervoid filaments was seen. Again, the form, &c. of infusory animals varies endlessly according not only to the quality of the substances, but even according to the dilution. Gruithuisen, in above a thousand experiments, never found them perfectly similar: and most infusoria, especially the simplest, appear in all sorts of infusions, whatever the solid, the water, or the gaz. The history of Entozoa, or animals living and produced in others, is also thought to favour the opinion of heterogenesis. Some are declared to be found no where externally, and to die if discharged, as some die if the animal dies in which they live; some are viviparous only; some inhabit the interior of solid organs, and it is known that blood-vessels and glandular ducts have no open mouths but allow liquids to transude only through their walls; and, as the ova of the oviparous are many times larger than the globules of the blood and could not enter the smallest vessels, it is thought impossible to explain the appearance of many entozoa by the transmission of ova. Every animal has its own entozoa, and they are found in vegetable feeders as well as those which prey on others. They appear in individuals whose parents never had them; and therefore, if they were created originally, our first parents must have had them all (and man is liable to above a dozen kinds of entozoa), and a complete collection often pass through very many generations without development. The paternal semen itself, — if both parents can transmit entozoa,—must contain the germs of the entozoa of all organs, and introduce them into the maternal ovum. They must pass through solid substances to get into the paternal semen or the fluid of the maternal ovum, and through solid substances again to reach the spots which become the habitation of the developed being. The germs of seminal animalcules must remain in the young male above twelve years undeveloped, we know not where, till semen is secreted, for these are found no where but in it; and, as the solids are continually changing, and the fluids not only continually, but in the most rapid manner, how the germs (which must be incapable of multiplication) could remain in the body is to me almost inconceivable. If the offspring is female, I suppose that they are refused admittance or are admitted and perish. Entozoa are found in the intestines of the embryo; in eggs; and in the bodies of other entozoa, nay even in the embryo within the bodies of other entozoa. Although seminal animalcules and those which inhabit mollusca and fish in such numbers (and one mussel has contained ten thousand of even one kind, besides others, and fish have them in every part of their eyes, in the vitreous, crystalline, &c.) flourish in the best health of the containing animal, ill health, in which the power to preserve sound composition is impaired, unquestionably predisposes to entozoa, as seen in the case of abdominal worms and vermin of the surface: and this fact is analogous to the circumstance of infusory animals and vegetables being produced under the decomposition of organic substances.

Mushrooms, although possessed of the power of propagation, often appear where propagation is inconceivable. The same circumstances favour their appearances as that of the entozoa: for instance, vegetable or animal matter in a state of decomposition,— decaying roots or wood, or vegetable ashes, as after stubble has been burnt in wet weather. The remains of mushrooms or entophyta (plants living in or on other systems) will give origin to others, as the remains of entozoa may, without propagation. When Spallanzani, for instance, sprinkled calcined mouldiness on bread, this became mouldy; but not if he sprinkled it on substances incapable of growing mouldy. They grow presently if the trunk of the white poplar is exposed near its root and moistened with yeast diluted with water. One sort appears in the jelly exuding from dying branches. They have appeared on the diseased surfaces of animals, as life declined. Mayer saw filiform mouldiness on the surface of the diseased lungs of a crow a few hours after death, and in the bronchiæ another sort; and other authors have noticed the same thing. Mouldiness has appeared on blistered, ulcerated, and gangrenous surfaces, some days before death. Certain champignons appear only on the decay of certain vegetables or animals, and of certain parts of vegetables and animals, and in certain proximate principles. The addition of an acid or an alcali is sometimes necessary, and determines their character. They are seen in the interior of animals and vegetables, as under the epidermis, in fruit, or in eggs; nay in trees within twenty or thirty rings of annual wood. Tallow dropped from candles in mines becomes mushrooms. Moisture produces them, if charged with organic substance. Air of some kind is requisite, but impure air favours them most; hydrogen is sufficient: and the kind of air affects their character. There is no doubt that confervæ may arise without propagation, and even from inorganic substances. A dilution of chloride of barium in distilled water, in a vial closed with emery for six months, has produced a new sort of conferva. The vegetable vesicle of the north, called red snow, adheres to snow or stones, and cannot be carried by the wind.

Even superior invertebrate animals appear sometimes in such a way as to make it almost probable that they have arisen by heterogenesis. Insects appear under the skin, as in the itch and within tumours, and occasionally in myriads, without any probability of external source. The insects of itch have never been seen to come out of themselves, crawl on the skin, and attach themselves to clothes; and yet the disease is contagious, and when a person is infected the eruption containing them spreads over the body: so that they are probably engendered by the disease, and are not the disease. Every animal has its own vermin. Man's louse is seen on no other animal: the eggs of a partridge were placed under a hen, and, when the young partridges were hatched, they had lice peculiar to them and different from those of the fowl. Medusæ disappear in winter; and sometimes abound prodigiously, especially after whirlwinds. A stream from a rock was arrested to make a fish-pond; in some years mussels were found in it, although mussels had never been seen in the pond whence the fish were taken to stock it. Worms and insects of various families have been discovered in subterranean cavities excluded from the air.

Sometimes phanerogamous plants and vertebrate animals have appeared in a very strange way. After the great fire of London, in 1666, the whole surface was presently covered with Sisymbrium iris, so that all Europe did not afford so many specimens. Similar facts have been observed after other great conflagrations. Tournefort relates that, after burning the fields in Provence and Languedoc, a large quantity of black poppies grew up, all of which disappeared the next year. After clearing away a forest in Nassau and burning the roots, the ground was covered with Spartium Scoparium; and Franklin says that in North America, near Slave Lake, poplars spring up where pines have been burnt. These phenomena, says Burdach, to whose industry I am indebted for all these illustrations, are quite analogous to the formation of different infusoria under different circumstances. If a salt spring rises up far from the sea, vegetables which grow near the sea show themselves all around. Tournefort saw the plants of marshes come up in a country which had been dry above a century and was afterwards covered some time with putrid water. In Denmark, after a pond, which had existed above fifty years, had grown dry, the aquatic plants disappeared, and the next year the soil was covered with plants which had never been seen there, and the seeds of which had not been in the ground, and one of which was not to be found in Denmark. Hoffman observed, in a tract of land taken from the sea, that different plants arose according to the nature of the soil at each part; as one was most impregnated with salt, another was fine sand, &c. The land had been under the sea from time immemorial; no traces of vegetable soil were discoverable; grain could not have been transported by the wind, for the plants sprung up rapidly; and none of the kind were to be found except at a considerable distance. They could not have been conveyed by springs in the ground, since these deposit all foreign substances: and "what a number of seeds would have been requisite, with these accidental means of dispersion, to cover the tract with so large a mass of vegetables, each fitted for the particular portion of soil!" Another wonderful fact is that the kind of new plant is determined by the preceding plant. The soil of cleared forests has been soon covered with a certain kind of trefoil; and, when trees planted on a heath have attained a certain age, the heath disappears and grasses and herbs come up which were not there before. Condamine informs us that, in Africa, ponds of rain water, dry during nine months of the year, are filled with fish when the rainy season returns. These are of a different kind from those of the nearest river, which is at the distance of three hundred fathoms, and has no connection with the marsh. If any eggs of fish had remained, they must have dried; and Spallanzani found that no fish's egg would hatch after having been dry for three months. Such facts are common. How lakes and streams of ice and snow water in Switzerland and the Pyrenees become peopled with trout and other fish is unaccountable; no less than the existence of fish found by Macartney in a pond lying in the middle of an island, which had sprung up from the bottom of the sea, far away from other land. The rapidity with which all the new animals and vegetables appear adds greatly to the difficulty.

What plants and animals which increase by homogenesis are ever produced by heterogenesis, it is difficult to say; though the advocates of the latter suppose all to have been so produced originally in the course of nature.

The simplest mode of increase in Homogenesis is by the detachment and independent existence of a portion of a system, — *accrementitial generation.* In this way many plants[i], polypes, some worms, and many animalcules multiply. If the detachment is a mere division of the system, it is termed *fissiparous generation.* This often coexists with more complicated modes, and is sometimes the result of peculiar circumstances only, and intended to make sure of a continuance of the organisation. The division may be unlimited, taking place in every direction, or limited, and then in a longitudinal or transverse direction only. The detachment may be of a distinct part which is prepared for the purpose and branches forth,—*gemmiparous generation,* common in polypes, and many vegetables, none of which, however, propagate in this way only: or the detachment may be of appendages containing two substances, one the new being, the other a stock of nourishment, —*propagular generation,* peculiar to vegetables. The other mode of Homogenesis is the secretion of something which is distinct from the parent before it is developed into a new being, — is secreted by the parent and retained as a distinct substance, till it is nourished and developed, almost always in some other part, sufficiently to leave the parent, — *secrementitial generation.* The substance may be globular, homogeneous, and of the same nature as the common mass of the parent, when it is termed a *spore,* and is found in vegetables and the lowest animals only; or it may be an *ovum,* or vesiculiform mass containing the rudiment of an embryo and a quantity of nourishment, and secreted by a particular organ called an *ovarium:* and the individual passes through many changes before it resembles its parent.

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[i] Hic plantas tenero abscidens de corpore matrum
Deposuit sulcis; hic stirpes obruit arvo,
Quadrifidasque sudes et acuto robore vallos;
Silvarumque aliæ pressos propaginis arcus
Exspectant, et viva sua plantaria terra;
Nîl radicis egent aliæ: summumque putator
Haud dubitat terræ referens mandare cacumen.
Quin et caudicibus sectis (mirabile dictu)
Truditur e sicco radix oleagina ligno.

Virgil. *Georgica,* Lib. ii.

All the modes of generation but that by eggs are accomplished through one individual only; — *Monogenesis* takes place. The mode by eggs may be accomplished through one individual or through two; — *Monogenesis* or *Digenesis* may take place.

Some organic beings, both vegetable and animal, which ordinarily copulate, will occasionally propagate by monogenesis. Thus not only have vegetables propagated by seeds for four generations, without the most indirect communication with the male organs; but various female insects kept separated from the first moment of their birth have laid fruitful eggs, and this has been observed through nine generations of complete exclusion from the male, so that there has been a race of virgin mothers, grandmothers, great grandmothers, &c.

CHAP. XXIX.

OF THE GENITAL FUNCTION IN MAN.

"The male genital fluid is produced by the two testicles, which hang in the scrotum, by their *spermatic chords*, through a ring called abdominal, or through, more properly, a fissure in the tendon of the external oblique muscle of the abdomen.[a] Besides abundant lymphatics, three orders of vessels are found in the testes: —

"The *spermatic artery*, which is, in proportion to the fineness of its calibre, the longest artery, by far, in the system, and usually conveys blood to the testicle immediately from the abdominal aorta.

"The *ductus deferens*, which carries to the vesiculæ seminales the semen secreted from the arterial blood.

"The *pampiniform plexus* of veins, which return to the cava or renal vein the blood remaining after secretion.[b]

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[a] Instances of more than two testes are extremely rare. Three, four, and even five, are said to have existed, and several authors declare that they have seen three in individuals many of whose families were equally well provided. (Dionis, *L'Anatomie des corps humains.* Demonstration quatrième. Sect. 1. Fernelius, Forestus, De Graaf, Borelli, &c. &c. Shenkius has collected several examples.) Unless such cases are related by an experienced medical man from his own observation, they deserve no credit; and even then must be regarded with suspicion, if anatomical examination or the peculiar pain of pressure have not proved the additional bodies to be analogous to testes no less in structure than in form and situation. The late eccentric Dr. Mounsey, who ordered that his body should either be dissected by one of his friends or thrown into the Thames, was found to have in his scrotum a small steatom, which during life might have given the appearance, though not the sensation on pressure, of a third testis.

The writers of such wonderful cases completely disagree in their account of the powers of these triorchides, tetrorchides, and pentorchides, some asserting them to be prodigious, others greatly below those of ordinary men.

One testis is commonly larger than the other, and, the right spermatic chord being for the most part shorter than the left, the right testis is generally the higher.

[b] The original situation of the testes accounts for the circumstance of their

"The testes are not originally suspended in the scrotum. In the very young male fœtus they are placed in a very different part, and the nature and successive changes of their situation that were first accurately investigated by Haller[c], but have since been variously stated, have given rise to various controversies.[d] I shall derive my account of this subject from the natural appearances which I have preserved in a great number of small embryos, dissected by me with this view.

"On opening the lower part of the abdomen of a young fœtus, there appears in each groin, at the ring of the oblique muscles, a very small opening in the peritonæum, leading downwards to a *narrow passage* which perforates the ring and runs to a peculiar sac that is extended beyond the abdominal cavity towards the scrotum, is interwoven with cellular fibres, and destined for the future reception of the testicle.

"At the posterior margin of this abdominal opening, there is sent off another process of peritonæum, running upwards, and appearing, in the young fœtus, little more than a longitudinal fold, from the base of which arises a small cylinder, or rather an inverted cone, that terminates above in a globular sac, containing the testis and epididymis, so that the testis at first sight resembles a small berry resting on its stalk, and appears hanging, like the liver or spleen, into the abdomen.

"The vessels, which afterwards constitute the spermatic chord,

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blood-vessels arising from the loins, as John Hunter remarked; for parts generally derive their vessels from the nearest source. The same applies to their nerves. Hence, too, the right spermatic artery frequently springs from the right renal as being nearer than the aorta, and the left spermatic vein frequently pours its blood into the left renal as being nearer than the inferior vena cava.

The original situation of the testes accounts also for the circumstance of the vas deferens arising from the lower part of the epididymis and bending upwards; in the fœtus this is not the case, but it is the necessary consequence of the subsequent change in the situation of the testes. (J. Hunter, *A description of the situation of the testis in the fœtus, with its descent into the scrotum*, in his *Observations on certain Parts of the Animal Economy*, p. 13.)

[c] "Haller's *Program. de herniis congenitis*, reprinted in his *Opusc. patholog.* p. 311. sq. vol. iii. Opera minora."

[d] "C. J. M. Langenbeck, *Commentatio de structura peritonæi, testiculorum tunicis, eorumque in scrotum descensu.* Gotting. 1817. fol.

B. W. Seiler, *Observationes de testiculorum ex abdomine in scrotum descensu.* Lips. same year. 4to."

are seen running behind the very delicate and pellucid peritonæum; the spermatic artery and vein descending along the sides of the spine, and the vas deferens passing inwards, in the loose cellular substance behind the peritonæum, towards the neck of the bladder. They enter the testis in the fold of peritonæum just mentioned.

"After about the middle period of pregnancy, the testis gradually descends and approaches the narrow passage before spoken of, the fold of peritonæum and its cylinder becoming at the same time bent down, until it lies directly over the opening of the passage.

"The testis being now ready for descent, the opening, which was hitherto small, becomes dilated, so as to allow the organ to pass it, the abdominal ring, and the whole passage, and to descend into the bulbous sac; after this occurrence, the opening soon becomes strongly closed and even grows together, leaving scarcely any vestige of itself in infancy.

"In proportion to the slowness with which the testis proceeded towards the opening, does its transit through the abdominal passage appear rapid, and, as it were, instantaneous. It is common to find the testis in mature fœtuses either lying over the peritonæal opening, or, having passed this, resting in the groin; but I have once only met with the testis, and then it happened to be the right and in a twin fœtus, at the very time when it was adhering, and in a manner strangled, in the middle of the passage, being just about to enter the sac; in this instance, the left testis had passed the abdominal canal and was already in the sac, and the abdominal opening of the same side was perfectly closed.

"This remarkable passage of the testis from the abdomen through the groin is limited to no period, but would seem to occur generally about the last month of pregnancy; the testicles are found, however, not very rarely in the abdomen or the upper portion of the groin at birth. For they have always another part of their course to finish, after leaving the abdomen, viz. to descend, together with their sac, from the groin into the scrotum.

"Repeated observation demonstrates this to be the true course of the testicles. To assign the *powers* and *causes* of its accomplishment is no easy matter. For I am every day more convinced that neither of the powers to which it is usually ascribed, viz. the action of the cremaster or diaphragm, or the mere contractility of the cellular membrane, interwoven with tendinous fibres, that exists in the cylindrical process of peritonæum and is called the Hunterian *gubernaculum*, is sufficient to explain so singular a movement, and least of all to explain the transit of the testis through the passage so often mentioned; but that the whole affords, if any thing does, a striking illustration of a vita propria, without the peculiar influence of which, so remarkable and unique a course, similar to no other function of the system, cannot even be imagined."[e]

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[e] The descent of the testes into the scrotum must, I apprehend, be owing to the growth of their nerves and vessels, and to the direction afforded by the contraction of the gubernaculum. Still the disposition of these to grow so long and of this to contract is a peculiar fact — a vita propria, in Blumenbach's words. The growth of the former, and therefore the whole process, is accounted for in the minds of some by the contraction of the latter. (Bichat, *Anatomie descriptive*, t. ii. p. 234.) Mr. Hunter's original account of the gubernaculum may not be unacceptable. "At this time of life, the testis is connected in a very particular manner with the parietes of the abdomen, at the place where, in adult bodies, the spermatic vessels pass out, and likewise with the scrotum. This connection is by means of a substance which runs down from the lower end of the testis to the scrotum, and which at present I shall call the ligament or gubernaculum testis, because it connects the testis with the scrotum, and seems to direct its course through the rings of the abdominal muscles. It is of a pyramidal form; its large bulbous head is upwards, and fixed to the lower end of the testis and epididymis, and its lower and slender extremity is lost in the cellular membrane of the scrotum. The upper part of this ligament is within the abdomen, before the psoas, reaching from the testis to the groin, or to where the testicle is to pass out of the abdomen; whence the ligament runs down into the scrotum, precisely in the same manner as the spermatic vessels pass down in adult bodies, and is there lost. That part of the ligamentum testis, which is within the abdomen, is covered by the peritonæum all round, except at its posterior part, which is contiguous to the psoas, and connected with it by the reflected peritonæum and by the cellular membrane. It is hard to say what is the structure or composition of this ligament: it is certainly vascular and fibrous, and the fibres run in the direction of the ligament itself, which is covered by the fibres of the cremaster or musculus testis, placed immediately behind the peritonæum. This circumstance is not easily ascertained in the human subject; but is very evident in others, more especially in those whose testicles remain in the cavity of the abdomen after the animal is full grown." (l. c. p. 6.)

It may here be mentioned that the human testes do not always descend into the scrotum, but occasionally remain, one or both, in the groin or abdomen. Individuals so circumstanced were called κρυψόρχιδες, or testicondi, by the ancients. A ridgil is a bull in which one only has descended. In these in-

"The coats of the testes, after their descent, are conveniently divided into *common* and *proper*.

"The common is the *scrotum*, consisting of the skin having a very moderate substratum of fat, and differing from the rest of the integuments in this, — that it is continually changing its appearance, being sometimes lax and pendulous, sometimes (especially during the venereal orgasm and the application of cold) constricted and rigid, and in the latter case singularly marked by rugæ and furrows.[f]

"With respect to the coats proper to each testis, the *dartos* lies immediately under the scrotum, and is endowed with a peculiar and strong contractile power, which deceived the celebrated Winslow, Haller, &c. into the belief of the presence of muscularity."

We know that the skin of every part relaxes by heat and contracts by cold, although it be not muscular: in the cold fit of an ague, it is constricted throughout so forcibly as to have acquired, during this state, the appellation of *Cutis Anserina*. The scrotum, being much more lax than any other portion of the skin, experiences these effects to the greatest extent. What is termed dartos is merely thick cellular membrane.

"Next to this, with the intervention, however, of much soft cellular substance, are found three orders of *tunicæ vaginales*[g]; viz. an exterior, *common* to the testis and spermatic chord, and to which the *cremaster* muscle adheres by disjointed bundles of fibres."

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stances the generative powers are not impaired; — a testicle which has not descended is prevented by the pressure of the neighbouring parts from fully evolving itself, but such persons, it is certain, "*militant non sine gloria.*"

[f] "Besides the assertion that the scrotum differs strikingly from the rest of the integuments in being reproduced after its destruction by gangrene; although many careful observers declare this reproduction, as it is termed, to be very imperfect, and even imaginary. See v. c. Stalp. v. d. Wiel. cent. 1. p. 364. Quirot, *Mém. de l'Acad. de Chirurg.* t. iv. p. 97." I knew a man whose scrotum had been destroyed by cold, during the late Duke of York's military career in Holland some years before, and it had not been reproduced.

[g] "J. E. Neubauer, *De tunicis vaginalibus testis et funiculi spermatici.* Giess. 1767. 4to.

F. L. Eichhorn, *De hydročele.* Gott. 1809. 4to."

This muscle arises from the superior anterior spinous process of the ileum, from the transversalis abdominis, the internal surface of the Fallopian ligament and neighbouring parts, and, passing through the ring, spreads upon the chord, vanishing upon the beginning of the testicle. Its office is evidently to support the testicle, and to draw it upwards against the groin during procreation. In those animals whose testes, instead of hanging in the scrotum, lie in the perinæum, in the groin, or in the abdomen, this muscle is, as might be expected, much less considerable. Its source is some fibres of the transversalis and obliquus internus muscles pushed by the testis before it in its descent.

"The two interior tunicæ vaginales are, one *proper* to the chord, and one to the testis; the latter of which usually adheres by its fundus to the common coat, but is internally moistened, like the pericardium, by a lubricating fluid.[h]

"The origin of these vaginal coats,—the subject of so much controversy, may, I think, be readily explained, from the circumstances already mentioned attending the descent of the testis.

"The coat *common* to the testis and chord arises from the descending bulbous sac or peritonæal process.

"The *proper* coat of the *testis*, from that production of the peritonæum which, ascending from the cylinder, originally invests the testis.

"The coat *proper* to the *chord*, from that fold and short cylinder of the peritonæum in which the fold terminates before it surrounds the testicle."

The old notion that each testicle, or each ovarium, is destined for the procreation of but one sex, is too nonsensical.

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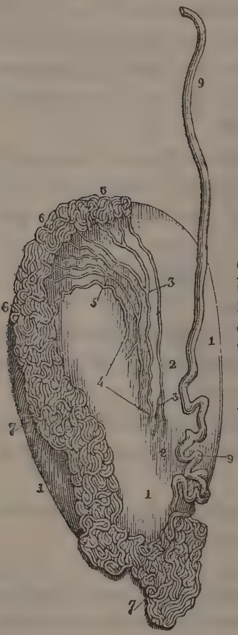
[h] A coat, exterior to the rest, is described by M. Roux, and termed *Envelope fibreuse*. It is an elongated sac, large below to contain the testis and epididymis, and narrow above, affording a sheath to the chord. It vanishes among the cellular membrane of the ring. (Bichat's *Anat. descrip.* t. v. p. 176.) M. Roux considers this coat as having been known to Haller, from the following passage in Haller's account of the testicle. "Ita fit ut interiores caveæ duæ sunt; superior vasculis spermaticis circumjecta; inferior testi propria." But Haller continues thus: "Ita sæpe se habet, ut etiam aquæ vis aut in partem testi propriam solam, intacta parte vasculosi funiculi, aut in istam solam, intacta testis vagina, effundatur, neque flatus impulsus de ea vaginali ad istam commeet." (*Elementa Physiologiæ*, t. vii. p. 420.) He appears therefore to describe merely the tunicæ vaginales of the chord and testis.

"To the body of the testis[i] there adheres very firmly, like the bark of a tree, a coat called *albuginea*, through the combination of which with the internal part of the vaginal coat, blood-vessels penetrate into the *pulpy substance* of the testis.[k] This pulpy substance is entirely composed of innumerable vessels, about a span in length[l], and convoluted into lobules, both conveying blood and secreting semen[m], the latter of which is carried, through the rete vasculosum of Haller[n] and the vasa efferentia of De Graaf, to the apices of the cones of the epididymis.[o]



1, 1, 1. Tunica albuginea. 2, 2. Seminiferous canals. 3. Cellular net-work of the testis. 4. Globules of mercury extravasated. 5. Excretory ducts forming the cones. 6, 6, 6. Cones formed by the continuation of the preceding ducts, and constituting the head of the epididymis. 7. Epididymis injected with mercury, and formed by one tortuous canal. 8. Tail of the epididymis, on a level with which the vas deferens begins. 9, 9. Vas deferens.—(Haller.)

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[i] "Alex. Monro, fil. *De testibus et de semine in variis animalibus.* Edinb. 1755. 8vo."

[k] "B. S. Albinus, *Annotat. Acad.* l. ii. tab. vii. fig. 1, 2, 3."

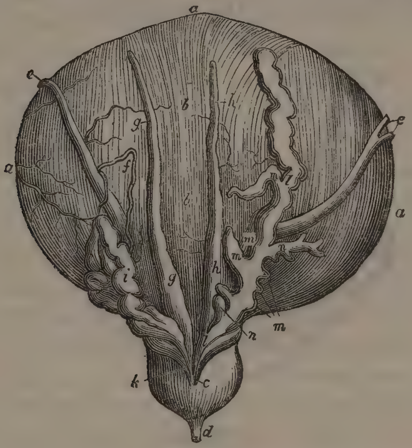
[l] "Vide Grew, *Museum Regalis Societatis,* p. 7."

[m] "The celebrated Sömmerring was so successful as to inject all the vessels composing the testis, and the entire head of the epididymis, with mercury. *Ueber die körperl. Versch. des negers vom Europäer,* p. 38."

[n] "Haller, *De viis seminis,* in the *Phil. Trans.* No. 494. fig. 1. *g. g.*"

[o] "De Graaf, *De Viror. organis generationi inservientibus.* tab. iv. fig. 1, 2."

" The *epididymis*, lying on the side of the testicle, and consisting of one vessel about thirty feet in length, is divided into about twenty glomerules or cones at the part called its head[p], and is continued into the vas deferens, at its lower part, which gradually becomes thicker[q] and is denominated its tail.



a, a. Bladder. *b, b.* Layers of posterior fibres, having a longitudinal direction. c. Prostate. *d.* Membranous portion of the urethra. *e, e.* Ureters. *f.* Some of the arteries of the bladder and of the vesiculæ seminales. *g, g.* Left vas deferens. *h, h.* Right vas deferens. *i.* Left vesicula seminalis in its natural position. *k.* Left ejaculator canal, traversing the prostate. *l, l.* Right vesicula seminalis. *m, m, m, m.* Cœcums or appendages of the vesicula seminalis. *n, n.* Some branching appendices. — (Haller.)

" Each *vas deferens*, ascending towards the neck of the urinary bladder and converging towards the other under the prostate gland, is then directed backwards and dilated into the vesiculæ seminales, in such a manner, that the common mouth both of the vesicles and vasa deferentia opens into the urethra, behind the caput gallinaginis.[r]

" The *vesiculæ seminales*, which adhere to the posterior and inferior surface of the bladder, surrounded by an abundance of fat, resemble two little intestines, winding in various directions, and branching into numerous blind appendices.

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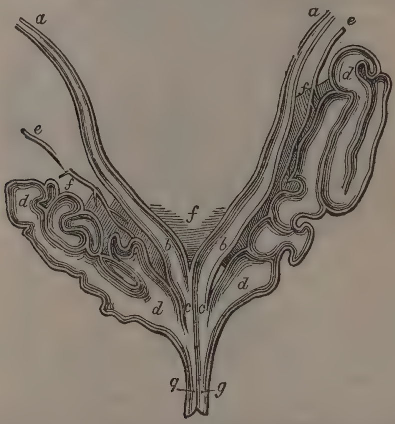
[p] " Vide Alex. Monro, fil. *Observations, Anatomical and Physiological.* Edinb. 1758. 8vo. tab. i. E. E. E. F. G. H."

[q] " B. S. Albinus, *Annotat. Acad.* l. ii. tab. iii. fig. 1."

[r] " B. S. Albinus, l. c. l. iv. tab. iii. fig. 1, 2, 3."

"They consist of two coats, nearly similar to those of the gall-bladder: the one strong, and of the description usually termed nervous (tendinous[s]); the other interior, delicate, abounding in cells, and divided into compartments by prominent ridges, like those found in the cervix of the gall-bladder.[t]



a, a. Portions of the vasa deferentia, whose sides are thick, and cavity very narrow. *b, b.* Portions of the same canals, with less thick sides, and larger cavity. *c, c.* Extremity of each vas deferens, which grows narrow again where it unites with the vesiculæ seminales and the ejaculator canal. *d, d, d, d.* Vesiculæ seminales inflated. *e, e.* Their arteries. *f, f, f.* Portion of the peritoneum covering the posterior part of the vesiculæ seminales. *g, g.* Ejaculator canals. — (Graaf.)

"In these passages is slowly and sparingly secreted and contained after puberty, the *semen*, a very extraordinary and important fluid, of a milky yellowish colour[u]," which is nearly the same in all animals; "of a peculiar odour," like that of a bone while being filed; of a styptic and rather acrid taste[x]; "of the same viscidity as mucus; opake; and of great specific gravity, of greater indeed than any other fluid in the body."[y] It is alcalescent, turning vegetable blues green and precipitating earths and metals from their solutions. In a few hours after removal from the body it becomes liquid and translucent, and, though previously insoluble in warm or cold water, is now very soluble in it. If exposed to the air, it dries into a horny looking substance.

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[s] The ancients gave the name of nerves to both nerves and tendons: the expression *distensio nervorum* is equivalent to *subsultus tendinum.* The white tendinous looking coat of the alimentary canal was therefore called by old anatomists, in classical language, the tunica nervea.

[t] "See, besides, the figures by Graaf, Haller, Albinus, and Monro, ll. cc. especially the beautiful one by Fl. Caldani, in his *Opusc. Anat.* p. 17."

[u] "The opinion of Herodotus respecting the black semen of Ethiopians, refuted in ancient times by Aristotle, has, to my surprise, been taken up in modern times by Le Cat, De Pauw, Wagler, &c."

"Semen has also this peculiarity, first observed by Lewis Hamme of Dantzic, in the year 1677[z], — of being animated by an infinite number of creatures, visible by the microscope, of the kind demoninated infusoria[a], and of different figures in different genera of animals. In man[b], these *spermatic animalcules*" (or spermatozoa, as Baer calls them,) "are oval, and have very fine tails: they are said to be found in prolific semen only," and therefore not in children, old men, or invalids, "so that they are in some degree an adventitious criterion of its prolific maturity; we say adventitious, because we hope, after so many weighty arguments and observations[c], there is no necessity at present to remark that they have no fecundating principle and much less are the germs of future offspring."

Hamme, when young, had discovered the seminal animalcules; he showed them to Leeuwenhoeck: and the sagacious Dutchman, catching eagerly at the discovery, published an account of them illustrated by plates. Hartzoeker, ambitious of the honour of the discovery, wrote upon the subject the following year and asserted that he had seen the animalcules three years before they were observed by Hamme. The subject, being the very summit of filthiness, excited the earnest attention of all Europe. Physiologists, naturalists, Popish priests, painters, opticians, and booksellers, all eagerly joined in the pursuit of the seminal animalcules, and the lascivious Charles the Second of England commanded them to be presented to him, swimming and frisking in their native fluid. Some of the curious could not find them. Others not only found them, but ascertained their length to be $\frac{3}{100000}$ of an inch, their bulk such as to admit the existence of 216,000 in a sphere whose diameter was the breadth of a hair, and their rate of travelling nine inches in an hour. They saw them too in the semen of all animals, and, what is remarkable, of nearly the same size and shape in the semen of the largest and of the smallest, — in the semen of the sprat and of the whale; they could distinguish the male from the female; in the semen of a ram they beheld them moving forwards in a troop, with great gravity, like a flock of sheep; and in the human semen, Dalenpatius actually saw one indignantly burst its wormy skin and issue forth a perfectly formed human being. The little creatures would swim in shoals towards a given point, turn back, separate, meet again, move on singly, jump out, and dive again, spin round, and perform various other feats, proving themselves, if not the most delicate, at least the drollest, beings that ever engaged the attention of philosophers. Their strength of constitution being an important object of inquiry, they gave proofs of their vigour, not only by surviving their rough passage through the urethra, three, four, and seven days, but by impregnating a female at the end of this time, and, on being removed from her, by impregnating even a second.

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[x] Burdach, § 83.

[y] "F. B. Osiander asserts "that fresh semen, emitted under certain circumstances, is occasionally *phosphorescent*." *De causa insertionis placentæ in uteri orificium.* Gotting. 1792. 4to. p. 16."

[z] "Vide Fr. Schrader, *De microscopior. usu in nat. sc. et anatome.* Gotting. 1681. 8vo. p. 34."

[a] "*Handbuch der Naturgesch.* p. 506. 10th edit. tab. i. fig. 13."

[b] "W. Fr. v. Gleichen, *Ueber die Saamen-und Infusionsthierchen.* Nurenb. 1778. 4to. tab. i. fig. 1."

[c] "Consult especially Laz. Spallanzani, both in his *Opuscoli di fisica animale e vegetabile,* Milan, 1776. 8vo. vol. ii., and in his *Dissertazioni,* &c. Ibid. 1780. 8vo. vol. ii."

Surely never was so much folly and bestiality before committed under the name of philosophy.

Abr. Kauw Boerhaave, Maupertuis, Lieutaud, Ledermuller, Monro Secundus, Nicolas, Haller, and, indeed, nearly all the philosophers of Europe, were satisfied of the existence of the animalcules. This, however, is another of the truths which were opposed at first. Linnæus disbelieved the observations of Hamme and Leeuwenhoeck, imagining the animalcules to be inert molecules, thrown into agitation by the warmth of the fluid. A thesis was published under his presidency to prove that they were only inert particles set in motion by some physical cause. Buffon and his followers, prejudiced in favour of an hypothesis, although they did not deny that the semen contained innumerable rapidly moving particles, contended that these were not animalcules, but organic particles. Many great names sided with Linnæus, and Lieberkuhn was considered to have absolutely *proved* that they were no animalcules.[d] Their reality, however, might be regarded as established. But, finally, to determine the question, and accurately to ascertain every circumstance relating to them, the celebrated Spallanzani began a long course of observations and experiments about the middle of the last century, unbiassed in favour of any opinion, and endeavouring to forget entirely all that had been written upon the subject. The human semen, the worthy Abbé assures us, he procured from dead bodies immediately after dissolution; but that of brutes was obtained either after death or during life.

He found in the former innumerable animalcules with an oval body and a tail, or appendix, tapering to a point. This appendix, by moving from side to side, propelled them forwards. They were in constant motion in every direction. In about twenty-three minutes their movements became more languid, and in two or three hours they generally died, sinking to the bottom of the fluid, with their appendices extended. The duration of their life, however, depended much upon the temperature of the weather; at —2° (Reaumur) they died in three quarters of an hour; while at 7° they lived two hours; and at 12½°, three hours and three quarters. If the cold was not too intense, they recovered upon the temperature being raised; when only —3° or —4° they recovered after a lethargy of fourteen hours and upwards; and, according to the less intensity of the cold, they might be made to pass from the torpid to the active state more frequently. They were destroyed by river ice, snow, and rain water; by sulphur, tobacco, camphor, and electricity. Even the air was injurious to them; — in close vessels their life was prolonged to some days, and their movements were not constant and hurried. They were of various sizes, and perfectly distinct from all species of animalcules found in vegetable infusions, &c. The seminal animalcules of different kinds of animals had generally each some peculiarity. In short, Spallanzani completely confirmed the principal observations of Leeuwenhoeck, and satisfactorily explained the sources of the inaccuracies of other inquirers.[e]

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[d] *Amœnit. Acad.* t. i. p. 79. Spallanzani, *Opusc. de Phys.* t. ii. p. 131.

Although these beings are most numerous in the semen, he detected them occasionally in other fluids; in the mesenteric blood of female frogs and salamanders, and in the blood of a tadpole and calf.[f]

They are supposed by some to originate by heterogenesis, and this both on account of the semen being so decomposible a fluid, as shown by its odour and readiness to change its nature and to liquefy: and of its long continued contact with the walls of its canals, contact of fluids with animal substances disposing them to deoxidise and decompose. Czermak[g] found that the fluid in birds at the beginning of the season contained no animalcules, and, afterwards, when they began to appear, that they were at first motionless: he also found animalcules disposed to move in some animals in the vas deferens only. Needham found their number augment when the semen became more liquid and apt to decompose; and Prevost and Dumas could not detect them in the thick semen of the seminal canals of mammalia till they had diluted it with water, — which in fact made an infusion of the animal matter.[h]

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[e] *Opuscoli di Fisica animale e vegetabile*, vol. ii. Prevost and Dumas have lately confirmed the observations of Spallanzani as to the semen of various animals. In the snail, the animalcules are fifty-four times larger than in the dog; in the mouse, half as large again as in the horse; and larger in some insects than in man. They are also more numerous in some of the lower animals, especially the mollusca. (*Annales des Sciences Naturelles*, t. i. and ii.) Leeuwenhoeck calculated that in the semen of a single fish there were thirty times as many animalcules as of human beings on the earth: — a beautiful confirmation of the fancy of proud man, that all other animals were made for him.

[f] Creatures of an inch to an inch and a quarter in length, and of the same general shape as the seminal animalcules, inhabit the mesenteric arteries of asses, horses, &c. Mr. Hodgson found them in seven asses out of nine. (*A Treatise on the Diseases of Arteries and Veins, &c.*) To increase the wonder, the intestines of the human *embryo* have been found containing worms. Goeze, *Versuch einer naturgeschichte der Eingeweidwürmer.* Living worms from external sources have frequently been found in the human blood. A case, in which many live larvæ of the Tipula oleracea were seen in blood twice taken from the arm of a boy at Dumfries, may be found in the *Dublin Journal of Med. and Chem. Sc.* for May, 1834: the eggs of this animal are very minute and deposited in running water; the boy lived on the banks of a river, and had frequently drunk the water.

[g] *Beyträge zu der Lehre von der Spermatzoen*, p. 20.

[h] Burdach, § 84.

Czermak divides them into three sections: — the Cephaloides, rounded; the Uroides, filiform; and the Cephaluroides, or those with one part rounded and another filiform.

In some days semen putrefies and becomes covered with the byssus septica.

According to Vauquelin's analysis of the semen[i], 100 parts contain,

Of Water	90
Mucilage	6
Phosphate of lime	3
Soda	1

"The genital fluid gradually collected in the vesicles is retained for subsequent excretion, and by its stay experiences changes nearly similar to those of the bile in the gall-bladder, — becoming more inspissated and concentrated by the removal of its watery portion.[k]

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[i] *Annales de Chimie*, t. x.

[k] "A paradoxical opinion was formerly entertained by some" (Wharton, Van Horne, Swammerdam, Harder) — "that the semen is not discharged from the vesiculæ seminales but from the vasa deferentia, and that the fluid of the vesicles is not truly spermatic and derived from the testis, but of quite another kind, and secreted in peculiar glands belonging to the vesicles. This has gained some advocates among the moderns. J. Hunter, *On certain Parts of the Animal Economy*, p. 27.

J. A. Chaptal, *Journal de Physique*, Febr. 1787, p. 101.

But it has been refuted by Sömmerring, in the *Bibliotheca Medica*, which I edited, vol. iii. p. 87.

Add the remarkable instances of men and other male animals possessed of vesiculæ seminales, that have discharged prolific semen after complete castration.

Consult, among others, the distinguished Elliotson in his English translation of these *Institutions*, p. 329. 3d edit. 1820."

The note to which Blumenbach does me the honour to allude was the following: —

John Hunter's arguments are — 1. "The semen, first discharged from the living body, is of a bluish white colour, in consistence like cream, and similar to what is found in the vasa deferentia after death; while that which follows is somewhat like the common mucus of the nose, but less viscid. The semen becomes more fluid upon exposure to the air, particularly that first thrown out; which is the very reverse of what happens to secretions in general. The smell of the semen is mawkish and unpleasant, exactly resembling that of the farina of a Spanish chestnut: and to the taste, though at first insipid, it has so much pungency, as, after some little time, to stimulate and excite a degree of heat in the mouth. But the fluid contained in these vesiculæ in a dead body, is

"For, as the whole of the testis and spermatic chord abounds in lymphatic vessels, which carry back to the blood a fluid with

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of a brownish colour, and often varies in consistence in different parts of the bag, as if not well mixed. Its smell does not resemble that of the semen, neither does it become more fluid by being exposed to the air." On opening two men immediately after death, the contents of the vesiculæ were of a lighter colour than he usually found them in persons who had been some time dead, and in one of the instances so fluid as to run out upon cutting the vesiculæ, but they were similar to the semen neither in colour nor smell. An examination of the vesiculæ of the horse, boar, rat, beaver, and guinea-pig, afforded the same results. In the last animal, the contents near the fundus of the vesiculæ were viscid, and gradually firmer, till, near the opening into the urethra, they were as solid as common cheese, and no such substance could be detected in the vagina of the female after her union with the male. 2. During lasciviousness, the testicles swell, and they become painful if the semen is not discharged; in coition, it may be added, they are drawn forcibly by the cremaster against the pubes, as if to assist the discharge of their contents at the period of emission. 3. In the old and debilitated, the vesiculæ are as full as in the young and vigorous. 4. Nay, in four men who had each lost a testicle, the vesicula on one side was equally full as on the other, although the men had survived the operation a considerable length of time. The same was discovered in two cases, where, by mal-formation, one testicle had no communication with the corresponding vesicle. In the gelding and the stallion their contents are similar and nearly equal in quantity. The vas deferens has no communication in some animals with the vesiculæ, and in others, as the horse, where a communication does exist, the common duct is not of sufficient length to permit the regurgitation of the semen into the vesiculæ. 5. Some animals, especially among the carnivora, have no vesiculæ seminales, yet in their copulation they differ not from those which have. M. Richerand indeed asserts that animals destitute of these organs are longer in coition than others, from having no reservoir for an accumulation of semen. (*Elémens de Physiologie*, c. x.) But he is mistaken. For, on inspecting Cuvier's account of animals without and with vesiculæ, no connection whatever appears between their presence or absence and the length of copulation.

In opposition to these arguments it is urged that a fluid, gently propelled along the human vas deferens, does not pass into the urethra, but regurgitates into the vesicula.* But, granting this true, we have no proof that the secretion of the testes leaves the vasa deferentia except during emission, when this regurgitation is impossible. It may also be contended that, in many men, the act of straining at the water-closet often instantly discharges from the urethra, without the least sensation, a large quantity of a fluid, which is exactly similar, in colour, consistence, and odour, to that of a nocturnal emission. The compression cannot squeeze this fluid from the testes. If a partisan of John Hunter should say that the *extremities* of the vasa deferentia afford it, we may reply to a seminal impregnation, and thus facilitate the secretion of semen in the manner before described; so the vesiculæ seminales are likewise furnished with a similar set of vessels, which, by absorbing the inert watery part, render the remaining semen more powerful.

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* Winslow, Ruysch, Duverney, and others, quoted by Haller: confirmed by Professor Wilson, *Lectures on the Urinary Organs*, p. 131.

"But I very much doubt whether genuine semen is ever absorbed during health; still more that it ever passes, as is sometimes asserted, into the neighbouring veins; and most of all, that by this absorption, if it does occur, unseasonable venereal appetites are prevented: since, if we compare the phenomena of animals, procreating at particular periods, with the constitution of those which are castrated, we must conclude that this

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him that John Hunter found them full of the same kind of fluid as the vesiculæ. I believe, however, that we are unacquainted with the pure secretion of the testes, and that far the greatest portion of an emission is secreted by the vesiculæ seminales and prostate gland; and that therefore some persons may, by forcing down, occasion a discharge apparently identical with an emission, though not containing a particle of matter furnished by the testes. The fact, mentioned at p.779., of emission occurring for a long period after the removal of both testes, — till the removal had much deranged the whole genital system, forcibly corroborates this idea.* The difference discovered by Mr. Hunter between the fluid found in the human vesiculæ seminales after death and that of an emission is nothing more than might be expected if we were certain that they were the same †, and, as the matter squeezed out by some in straining exactly resembles that of a regular emission, this fact alone would be fatal to Mr. Hunter's opinion, in regard to man, unless we relinquish the notion of the fluid of human emission being chiefly true semen from the testes. In the herisson and rabbit the vesicle opens separately from the vas deferens, so that in these animals it cannot be a seminal receptacle; and yet in the rabbit Prevost and Dumas found seminal animalcules in the vesicle, showing, perhaps, that the organ itself secretes a genital fluid.

In different species of brutes the fluid of emission may be furnished in different proportions from the testes, vesiculæ, and prostate, and the effects of pressure from straining are unknown in them. Additional vesiculæ seminales are sometimes seen opening separately. Cuvier says that the muscular part of the urethra in brutes is full of semen at rutting time, so that it may pass into the additional vesiculæ.

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[*] Dr. Otto says that he found semen in a vesicle nine months after castration. *Seltene beobachtungen*, t. i. p. 131.

[†] In the two men opened by J. Hunter soon after death, the vesicular fluid was actually much less brown than usual.

absorption is rather the cause of ungovernable and almost rabid lust.

"We conceive that this end is accomplished in a very different mode,"—"by *nocturnal pollutions*, which we regard as a natural[l] excretion, intended to liberate the system from the otherwise urgent superfluous semen, more or less frequently, according to the variety of temperament and constitution."[m]

"The semen is never discharged pure, but mixed with the *prostatic fluid*, which is very much of the appearance of the white of egg, and has acquired its name from the organ by which it is produced,—an organ of some size, of a peculiar and very compact texture, lying between the vesiculæ seminales and the bulb of the urethra, and commonly denominated *prostate gland*."[n] It is composed of minute cells, from which excretory ducts proceed, opening by twenty or thirty orifices into the urethra on the sides of the verumontanum.

Hence, as well as from the secretion of the vesiculæ seminales and urethral mucus, some men have perfectly performed the act of copulation, though unfruitfully, after castration.[o] Many such accounts are suspicious; but, in a man castrated by Sir Astley Cooper, the complete power of coition was said positively to remain for twelve months after the operation, and afterwards rapidly declined[p]; and in another case of castration by Professor Wilson complete copulation was occasionally performed for a year or more.[q]

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[l] "Ch. R. Jaenisch, *De pollutione nocturna.* Gotting. 1795. 4to.
Aug. Gottl. Richter, *Specielle Therapie*, vol. iv. p. 552. sq.
C. W. Hufeland, *Abhandl. der Königl. Akademie der Wissensch. in Berlin*, 1819. p. 170."

[m] "I willingly grant that barbarous nations, of a phlegmatic temperament and copulating promiscuously, do not require this excretion; but I must contend that it is a perfectly natural relief in a young man,—single, sanguineous, full of juices, with a strong imagination, and living high, although enjoying the completest health."

Blumenbach has not been able to discover that nocturnal pollution happens to any animal except man; but a person who had been keeper of the beasts at Exeter Change and the Surrey Zoological Gardens for twenty years, informed me that he had often seen male animals, chiefly of the feline and canine kind, agitated in sleep, and wake up with an emission, and had seen seminal discharges where they had slept; and that they, especially the canine, as well as the great elephant Chuny, which was shot, would onanise by striking the penis on the ground or rubbing it against something, and some by shaking themselves. At Turin the keeper also assured me that the great elephant onanised continually against the ground in March and April. Monkeys, I was told, actually masturbate (*manu*-stuprate) like many boys.

[n] "Morgagni, *Adversar. Anat.* iv. fig. 1, 2."

[o] See examples collected by Schurig, *Spermatologia*, p. 395. sq.

The generative powers are not impaired by the removal of one testis: the Hottentots have been said frequently to deprive their sons of one, on arriving at eight years of age[r], from the belief that monorchs are swift runners. We read in Varro that if a bull is admitted to a cow immediately after both testes are removed, impregnation takes place, — " Exemptis testiculis, si statim admiseris, concipere (vaccas)."[s]

" The male *urethra* is the common outlet of three different fluids, — the urine, semen, and prostatic liquor. It is lined with mucus, which proceeds from numerous sinuses dispersed along the canal.[t] We find it surrounded by a spongy texture, upon which lie two other *spongy bodies*[u], of much greater thickness, constituting the major part of the penis. The penis is terminated anteriorly by the *glans* — a continuation of the spongy texture — and usually covered by a delicate and very moveable skin, which is destitute of fat, and, at the corona of the glans, forms the preputium, and freely moves over the gland, nearly as the eyelids do over the eyeball. The internal duplicature of the preputium, changing its appearance, is reflected over the glans, like the albuginea of the eye, and is beset at the corona with many Littrian[x]

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[p] *Obs. on the Structure and Diseases of the Testis*, p. 53. sq. 4to. London, 1830.

[q] *Lectures on the Structure and Physiology of the Male Organs, &c.* p. 132. sq. London, 1821.

[r] Wilh. ten. Rhyne, *De promontor. Cap. bon. spei*, 22. pag. m. 64, and others quoted by Schurig, *Spermatologia*, p. 60. Sparmann informs us that this custom no longer prevails.

[s] *De Re Rustica*, ii. 5. See De Graaf, *De mulier. org. generat. inserv.* p. 82.

[t] " J. Ladmiral, *Effigies penis humani.* LB. 1741. 4to."

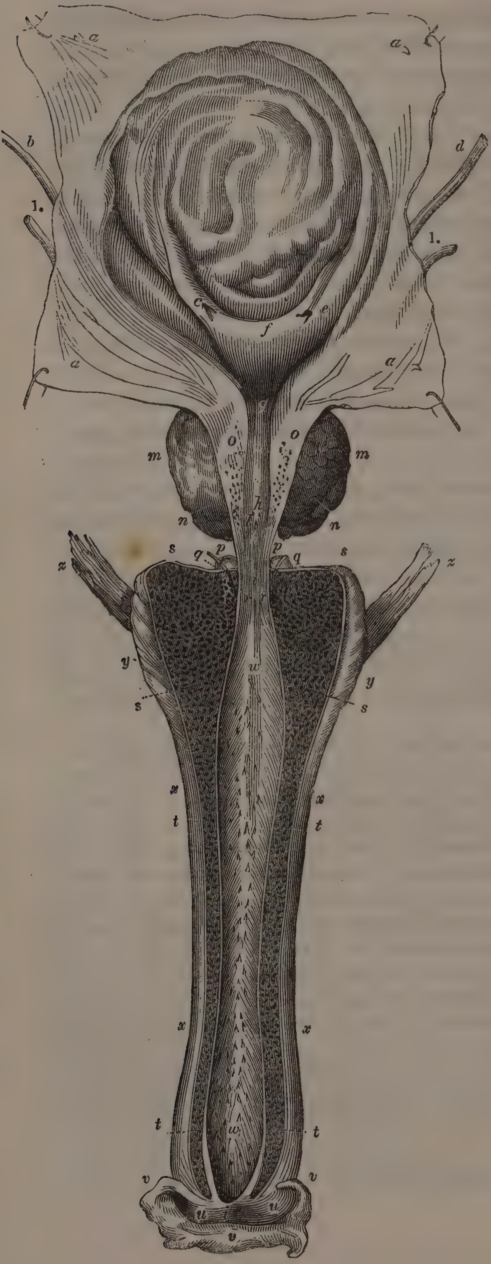
[u] " Ruysch, *Observat. anat. Chirurg. Centur.* p. 99. fig. 75—82.

And his *Ep. problemat.* xv. fig. 2. 4. 6, 7.

T. H. Thaut, *De virgæ virilis statu sano et morboso.* Wirceb. 1808. 4to. fig. 1.

The distinguished Home has clearly and faithfully displayed this truly cellular or spongy texture of the cavernous bodies of the penis, that was lately in general confounded with the blood-vessels in which it abounds. *Phil. Trans.* 1820. P. ii. p. 183. sq."

[x] " Morgagni, *Adversar. Anat.* 1. tab. iv. fig. 4. *i. k.*"



a, a, a, a. The bladder opened crucially.
b. Right ureter.
c. Its opening into the bladder.
d. Left ureter.
e. Its opening into the bladder.
f. Base of the trigon vesicale.
g. Its summit, forming the luette vesicale.
h. Swollen portion of the verumontanum.
i. Its summit, continuous with the canal of the urethra.
k. Excavation of the verumontanum
l, l. Openings of the ejaculatory canals at its sides.
m, m. External surface of the prostate, cut.
n, n. Section of the prostate.
o, o. Orifices of its excretory ducts.
p, p. Membranous part of the urethra.
q, q. Cowper's glands.
r, r. The openings of their ducts into the urethra.
s, s, s, s. Bulb of the urethra, cut.
t, t, t, t. Corpus spungiosum urethræ, cut.
u, u. The glans, also cut.
v, v, v. The prepuce, cut and turned back.
w, w. The urethra divided longitudinally, so as to show its inner surface.
x, x, x, x. Corpora cavernosa penis.
y, y. Bulbo-cavernous muscles.
z, z. Ischio-cavernous muscles.
1, 1. Vasa deferentia.

(Loder.)

glands, similar to the Meibomian of the eyelids, and secreting a peculiar smegma."[y]

The corpus spongiosum of the urethra, and the two corpora cavernosa, have the appearance of cells, but are really veins freely communicating with each other, and much larger in the corpora cavernosa than in the corpus spongiosum. The arteries ramify between them, and Müller says that some project into the veins, and pour blood directly into them.

"The virile organ, thus constructed, possesses the power of *erection*, — of becoming swollen and stiff, and changing its situation, from the impetuous congestion and effusion[z] of blood into its corpora cavernosa either by corporeal or mental stimulus, and of detumifying and collapsing after the return of the blood."[a]

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[y] "This smegma in young men, especially when they are heated, is well known to accumulate readily and form an acrimonious caseous coagulum. The inhabitants of warm climates are particularly subject to this inconvenience, and the chief use of *circumcision* appears to be the prevention of this accumulation. We know that for this reason Christians, in the scorching climate of Senegambia, occasionally cut off the preputium, and that uncircumcised Europeans residing in the East frequently suffer great inconvenience. Guido de Cauliaco, the celebrated restorer of surgery in his day, who flourished in the middle of the fourteenth century, said that circumcision was useful to many besides Jews and Saracens, "Because there is no accumulation of sordes at the root of the gland, nor irritation of it." *Chirurg. Tr.* vi. doctr. ii. p. m. 111."

[z] "Vide Theod. G. Aug. Rooze, *Physiologische Untersuchungen*. Braunsv. 1796. 8vo. p. 17."

[a] "A phenomenon worthy of remark, even from the light which it promises to throw on this function in general, is the erection so frequently observed in those who are executed, especially if strangled.

Consult, besides Garmann's compiled farrago (*De Miraculis Mortuorum*, I. xi. 7. sq.)

Morgagni, *De sed. et caus. morb.* xix. 19. sq."

As Gall is right in placing the seat of sexual desire in the head, this kind of erection may be explained by supposing the irritation, arising in the cerebellum from the great accumulation of its blood, to produce a correspondent irritation in the organs of generation: thus the epileptic paroxysm is not unfrequently accompanied by an emission. Nocturnal emissions occur most frequently after a person has been long in bed and supine, — the cerebellum being below all the rest of the encephalon, if the occiput is, as usually, raised by a pillow. That may, however, be explained by the urine accumulating in the bladder during the continuance of repose, and stimulating the generative parts connected with this receptacle the more readily in the supine posture; and this view is countenanced by the large quantity of urine generally made on waking after nature has been thus relieving the chaste unmarried man.

Accumulation of blood, it is supposed, may be produced in three ways. 1. By a mechanical impediment to its return: but there is no reason whatever to ascribe ordinary erection to compression. 2. By an increased flow of blood to a part, so that the vessels receive it faster than they convey it away. Here the vessels of the part itself in which the accumulation exists are said by some to act more violently than usual; by others, the neighbouring larger vessels which supply these: their frequency of action, however, is not increased, but always remains correspondent with that of the heart. Were the vessels of the part itself to act more violently than usual, that is to say, to contract to a smaller and relax to a greater dimension than usual, (though an ordinary alternate contraction and relaxation are hypothetical,) more blood would indeed subsist in them during their relaxation, but less than usual would subsist in them during their contraction, and there could be no accumulation, no inflammation. If the neighbouring large vessels act more violently than usual, (though their ordinary alternate contraction and relaxation are also hypothetical,) they may be conceived to produce an accumulation of blood and a distension of the capillaries and veins. 3. If the vessels of any part become dilated, and do not contract in proportion, this circumstance will be sufficient to produce an accumulation, without any necessity for supposing an increased action of the neighbouring larger vessels. This explains inflammation: and in Bichat's *Anatomie Descriptive*, this explanation is given of erection. The arteries and the corpora cavernosa (which always contain florid blood) spontaneously dilate, and accumulation ensues. For this purpose it is not necessary that they should be muscular, but Mr. Hunter asserts their muscularity: in a horse he found them muscular to the eye, and they contracted upon being stimulated.

The heart, however, as in all cases of what is called increased determination of blood, lends its powerful aid by acting with augmented force.

As to the final cause of erection, the organ, by acquiring increased bulk, firmness, and sensibility, becomes adapted for affording and experiencing to the utmost extent the effects of friction both as exciting pleasure and as stimulating the secreting vessels; the increased length and narrowness of the urethra render the emission more forcible.[b]

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[b] Mr. Shaw pointed out a venous network running along the inside of the urethra, but accumulated at what is called the membranous part, connected with

" When in a flaccid state, the penis is considerably bent at its origin from the neck of the bladder [c], and thus perfectly adapted for the discharge of the urine, but quite unfit for the emission of semen [d], because the beginning of the urethra then forms too acute an angle with the openings of the seminal vesicles.

" The emission of semen is *excited* by its abundance in the vesicles, and by sexual instinct; it is *effected* by the violent tentigo which obstructs the course of the urine, and, as it were, throws the way open for the semen; by a kind of spasmodic contraction of the vesiculæ seminales; by a convulsion of the levatores ani [e] and of the acceleratores urinæ; and by a succussion of the whole system, short and less violent, though almost of an epileptic nature, and followed by depression of strength.[f]

The discharge of semen resembles the discharge of the fluids of other glands. It is excited by the abundance of the fluid,

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the corpus spongiosum, and forming two columns with a groove in the middle. This must principally assist in narrowing the canal during erection, and, as the columns unite before the prostate, must also contribute to prevent the semen from moving towards the bladder, or the urine from flowing from the bladder. *Med. Chir. Trans.* vol. x.

[c] " See Camper, *Demonstration. anat. pathologic.* L. ii. tab. iii. fig. 1."

[d] " Gysb. Beudt, *De fabrica et usu viscerum uropoieticorum.* LB. 1774. 4to. reprinted in Haller's Collection of Anatomical Disputations, t. iii. tab. iii."

[e] " Carpus in Mundinum, p. 190 [b]. and 310."

[f] " For which reason Zeno, the father of the Stoic philosophy, called the loss of semen the loss of part of the animating principle."

Zeno's practice was conformable to his principles. He is recorded to have embraced his wife but once in his life, and then out of mere politeness.

Zenobia, the celebrated Queen of Palmyra and the East, was as extraordinary a wife. She never admitted her husband's embraces but for the sake of posterity, and, if her wishes were baffled, she reiterated the experiment in the ensuing month. (*Augustan History*, quoted by Gibbon, *Decline and Fall, &c.* vol. ii. p. 33.)

Epicurus, Democritus, &c. were nearly of the same opinion with Zeno; and the Athletæ, that their strength might be unimpaired, never married. The Rabbies, in their anxiety to preserve their nation, are said to have ordered, with the view of preventing the loss of vigour, that a peasant should indulge but once a week, a merchant but once a month, a sailor but twice a year, and a studious man but once in two years. Moses forbad indulgence before battle. Many plants die as soon as they have flowered: stags and fish are emaciated after the sexual season, and the latter are no longer fit to eat: while the prevention of fructification by the removal of the sexual organs renders annual plants biennial and the latter triennial.

by mental or local stimulus, but most by mechanical irritation of the extremity of the excretory duct, for in such a point of view must be regarded the friction of the glans penis in copulation. The fluid is accumulated in the bulb of the urethra, since it must be accumulated somewhere to be emitted so copiously, and no other use can be assigned to the bulb, and, if the vesiculæ do not receive it, no other part than the bulb can; besides, it is upon the bulb that the muscular contraction of the venereal paroxysm first acts. "The semen acting as a stimulus to the cavity of the bulb of the urethra, the muscles of that part of the canal are thrown into action, the fibres nearest the bladder probably act first, and those more forward in quick succession, and the semen is projected with some force. The blood in the bulb of the urethra is by the same action squeezed forward, but, requiring a greater impulse to propel it, is rather later than the semen, on which it presses from behind; the corpus spongiosum, being full of blood, acts almost as quick as undulation, in which it is assisted by the corresponding constriction of the urethra, and the semen is hurried along with a considerable velocity."[g]

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[g] Hunter, *Observations on the glands situated between the rectum and bladder, called vesiculæ seminales,* l. c. 45.

CHAP. XXX.

OF THE GENITAL FUNCTION OF WOMAN IN GENERAL.

"As the male organs are fitted for giving, so the female organs are fitted for receiving, and are correspondently opposite to the former. In some parts, the organs of both sexes are very analogous to each other in structure. Thus the *clitoris*, lying under the pubes in the superior commissure of the labia, agrees in many respects with the penis of the male, although distinct from the urethra, and therefore imperforate, and extremely small in well-formed women. It is recorded to have been, in some adult females, of as comparatively large size as we stated it usually to be in the fœtus, and these instances have probably given rise to most of the idle stories of hermaphrodites.[a] Like the penis, it has its corpora cavernosa, is capable of erection, is covered with a prepuce, and secretes a smegma not dissimilar from the Littrian.[b]

[a] "Vide Haller, *Comment. Soc. Scient. Gotting.* vol. i. p. 12. sqq.

And among the moderns, D. Clarke in Sir Everard Home, *Phil. Trans.* 1799. p. 163."

[b] "In warm climates it, too, is liable to accumulation and acrimony, and has hence been the occasion of the custom of female circumcision in many hot parts of Africa and Asia. Carst. Niebuhr has given a view, executed to the life, of the genitals of a circumcised Arabian female, eighteen years of age, whom he himself was singularly fortunate in examining during his Oriental tour. *Beschreib. von Arabien,* p. 77. sq.

And Osiander, *Denkwürdigkeiten für die Heilkunde, &c.* vol. ii. tab. vi. fig. 1."

This custom is mentioned even by Strabo. Burckhardt states that "the daughters of the Arabs, Ababde and Djaafere, who are of Arabian origin, and inhabit the western bank of the Nile, from Thebes, as high as the cataracts, and generally those of all the people to the south of Kenne and Esne, as far as Sennaar, undergo circumcision, or rather excision of the clitoris, at the age of from three to six years." The healing of the wound is contrived to close the genitals, excepting at one point for the passage of the urine, and, as the adhesions are not

"From the clitoris the *nymphæ* descend, also occasionally of great size[c], which has been the source of other idle tales[d], and,

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broken through till the day before marriage, and then in the presence and with the assistance of the intended bridegroom himself, no doubts of the fair's virginity can harass his breast. *Travels in Nubia,* p. 332. sqq.

The same traveller, as well as Browne and Frank, relates that many slave girls have their genitals sewn up, and, like eunuchs, become more valuable on account of their unfitness for sexual connection. "Mihi contigit," says he, "nigram quandam puellam, quæ hanc operationem subierat, inspicere. Labia pudendi acu et filo consuta mihi plane detecta fuere, foramine angusto in meatum urinæ relicto." He adds, "Apud Esne, Siout, et Cairo, tonsores sunt, qui obstructionem novacula amovent, sed vulnus haud raro lethale evenit."

The adhesion may prevent admission of the male organ, but, like a dense hymen, does not always prevent impregnation. In the *Med. Chir. Trans.* vol. xi., a female of the Eboe nation is mentioned as having been at an advanced stage of pregnancy, in Jamaica, notwithstanding that, in consequence of this operation, performed upon her when a child, in her native land, "a cicatrix extended from the mons veneris to within an inch of the anus, where there existed a small orifice barely sufficient for the introduction of a small female catheter, through which orifice the urine and menses exuded. The adhesion being removed by an incision with a sharp-pointed bistoury, the delivery was easily accomplished." A case is mentioned by Professor Rossi (*Archives générales*, Oct. 1827), of impregnation with no other canal than one, just sufficient to admit a small sound, opening within the anus. Examples of the necessity for cutting or tearing the hymen, at the time of labour, may be found in Ruysch, Mauriceau, and F. Hildanus, &c., and in the *Transact. of the London Medical Society*, vol. i. P. 2. When the hymen is imperforate, impregnation obviously never occurs, and an incision is required for the escape of the accumulated menstrual fluid. See *v. c.* Ambrose Paré, lib. xxiii. c. xlii. or the *Med. Records and Researches.* Harvey mentions a beautiful white mare belonging to the queen, in which the entrance of the vagina had been fastened up by iron rings to prevent her being covered, but, to the surprise of every body, she was one day found to have foaled, and her offspring, in coming forth, had lacerated the vagina on one side of the rings, which still retained their situation. *De Partu Exercit.* p. 557. *Opera.*

[c] "Their number likewise has occasionally varied. Vide Neubauer, *De triplici nympharum ordine.* Jenæ, 1774. 4to."

[d] "I allude to the singular ventral skin of the Hottentot women. Wilh. ten. Rhyne, from personal inspection long ago, considered it as enormous pendulous nymphæ. *De promontorio b. spei*, p. 33.

I have treated this point at large in my work, *De Gen. Hum. Var. Nat.* 242. ed. 3.

Steller relates something similar in regard to the Kamtschatkan women. *Beschreib. v. d. Lande Kamtschatka*, p. 300."

like the clitoris, possessing a high degree of sensibility. They appear in some measure to direct the stream of urine, because the *opening of the urethra*, which is very short in females, lies under their commencement; and it is frequently ciliated, as it were, with small papillary folds."[e]

The clitoris and nymphæ are termed the inner half ring, and compared to the corolla; while the labia and mons veneris are called the external, and compared to the calyx, of flowers.

"Under the termination of the urethra lies the *opening of the vagina*, surrounded by various kinds of cryptæ, *v. c.* the lacunæ uretheric æ of De Graaf[f], and the orifices of the prostates, as they are improperly termed, of Casp. Bartholin[g], which secrete an unctuous mucus.[h]

"Across the opening of the vagina the *Hymen*[i] is extended,— a membrane generally circular, and found, as far as I know, in the human subject only, of this form and in this situation.[k]

Blumenbach, on the authority of Le Vaillant, states it to be a prolongation of the labia, but we are now certain that W. ten. Rhyne was correct, and that it is a prolongation of the nymphæ, which often hang five inches below the labia. (Dr. Somerville, *Med. Chir. Trans.* vol. vii. 1816. Barrow, *Travels into the Interior of Southern Africa*, vol. i.) It is this same tribe of Hottentot women that have another connate singularity in the same quarter, common also to a variety of their sheep, and the source of all the charms of the Hottentot Venus — a brilliant example of denomination on the principle of *lucus a non lucendo,* mentioned at p. 702., and of whom an account is given by Cuvier, *Mémoires du Muséum*, t. iii. p. 269.

[e] "I find the opening of the urethra surrounded by very beautiful cutaneous cilia of this kind, in a remarkable specimen of the genitals of a woman upwards of eighty years of age. The hymen is entire, and all the other parts most perfectly, and, as it were, elaborately, formed. They are preserved in my museum, and my friend and colleague, Osiander, has represented them in a plate. l. c. tab. v."

[f] "See J. James Huber's plates of the uterus, among those of Haller, fasc. 1. tab. ii. fig. 1. *g*."

[g] "Ibid. fig. 1. *b*: *b*. — fig. 5. *d*."

[h] "Such also are the two foramina, very frequently observed in living women by J. Dryander, at the extremity of the vagina. Nic. Massa, *Epist. Medicinal,* t. i. page 123. b."

[i] "John Wm. Tolberg, *De Varietate Hymenum.* Hal. 1791. 4to.
Osiander, l. c. tab. i.—vii."

[k] "*Handbuch der vergleich, Anat.* p. 472. Respecting parts somewhat analogous

"The remains of the lacerated hymen become the *carunculæ myrtiformes*, which are of no regular number, and are infallible signs of the loss of virginity.[1]

"The *vagina*, ascending between the urinary bladder and rectum, consists of a very vascular cellular parenchyma, is surrounded inferiorly by the *constrictor cunni*[m], and lined internally with a very soft coat, which is marked by two very beautiful *columns of rugæ*[n],—an anterior and posterior[o], pouring forth a mucus into its cavity.

"Upon the superior part of the vagina rests the *uterus*, suspended on either side by its broad ligaments.

"Its cylindrical cervix[p] is embraced by the vagina, and perforated by a narrow canal, which, like the vagina, is marked by rugæ denominated the arbor vitæ, and is generally lined with a viscid mucus at each opening, but particularly at the superior or internal.

"The substance of the uterus is peculiar,—a very dense and

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in some brute females, see the distinguished Duverney, *Mém. présentées, &c.* physical class, t. ii. p. 89."

[1] Cuvier declares that he has found the hymen in very many mammalia (*Leç. d'Anat. comp.* t. v. p. 131, 132.), overthrowing the doctrine, so strenuously maintained by Haller, of its existence for moral purposes. And, were it confined to the human female, the various size of its aperture, and the various firmness of the organs, must ever leave those in uncertainty who can on their marriage indulge in sensual doubts. We read, in Hume, that Henry the Eighth, who certainly had his share of experience, boasted his discrimination (*History of England*, ch. xxxii.); but in the East the difficulty was in ancient times proverbial. (*Proverbs*, xxx. 19.) The lover of Italian literature knows how exquisitely natural is every description of Boccacio's, and will recollect his story of the daughter of the Sultan of Babylon:—"Essa, che con otto uomini forse diecemilia volte giaciuta era, allato a lui (al Re del Garbo) si coricò per pulcella, e fecegliele credere, che così fosse: e Reina con lui lietamente poi più tempo visse: e perciò si disse: Bocca basciata non perde ventura, anzi rinnuova, come fa la luna." (*Decamerone*, Giornata seconda, Novella vii.)

[m] "Eustachius, tab. xiv. fig. i. XX.
Santorini, *Tab. Posth.* xvii. 1. 1."

[n] "Huber, *De Vaginæ Uteri structura rugosa, necnon de Hymene.* Gotting. 1742. 4to."

[o] "Vide Haller, *Icones Anat.* fasc. ii. tab. vi. fig. 1, 2."

[p] "Roederer, *Icones Uteri Humani*, tab. vii. fig. 2, 3, 4."

compact parenchyma[q] abounding in blood-vessels, which run in a curious serpentine direction[r], and the veins are destitute of valves. It has also on its external surface a supply of lymphatics[s], and of nerves[t], which occasion its remarkable sympathy with other parts.

"The uterus is covered externally with peritonæum; its internal cavity is small, and lined, especially at the fundus, with a soft and very delicate spongy membrane, which is composed, according to some, of colourless arteries and veins, and[u], according to others, of lymphatics."[x]

The muscularity of the uterus is denied by Malpighi, Walter, Ribke, &c.[y], and by Blumenbach, who says, "I have never yet discovered a true muscular fibre in any human uterus which I have dissected, whether impregnated or unimpregnated, recent or prepared; and it must be allowed, by those who maintain the muscularity of the uterus, that the fibres, which they call muscular, have qualities very different from those of all others in the system, especially since they themselves entertain doubts of the existence of nerves in the substance of the uterus, without which one cannot imagine a true muscle. I am daily more convinced that the uterus has no true irritability; but, if any part of the body has, a vita propria, perfectly correspondent with the peculiar motions and functions of the uterus, which are not referable to any properties common to the similar parts, and which appeared to the ancient physicians and philosophers so peculiar, that the uterus was by them denominated an animal within an animal."[z]

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[q] "J. Gottfr. Weisse (Præs. Rud. Boehmer) *De Structura Uteri non musculosa, sed cellulosa vasculosa.* Vitemb. 1784. 4to.

I. G. Walter, *Was ist Geburtshülfe.* Berlin, 1808. 8vo. p. 54."

[r] "Id. *De Morbis Peritonæi,* tab. i. ii."

[s] "Mascagni, tab. xiv."

[t] "Walter, *Tab. Nerv. Thorac. et Abdom.* tab. 1.

J. F. Osiander, *Commentatio præmio Regio ornata, qua edisseritur uterum nervos habere.* Gott. 1808. 4to."

[u] "Ferrein, *Mémoires de l'Acad. des Sc. de Paris,* 1741. p. 375."

[x] "Mascagni, l. c. page 4."

[y] "Consult, besides the great Malpighi, Walter, *Betracht. über die Geburstheile des weiblichen Geschl.* p. 25. sq.

Chr. H. Ribke, *Ueber die Structur der Gebährmutter.* Berl. 1793. 8vo.

But chiefly J. F. Lobstein, *Magasin Encyclopédique, redigé par* Millin, vol. xlix. 1803, t. i. page 357. sq."

But its muscularity is allowed by Morgagni, Mery, Littre, Astruc, Ruysch, Monro, Vieussens, Haller, &c.[a]: and Sir Charles Bell gives the following description of the muscular structure of this organ: —

"The muscularity of the uterus is proved by direct ocular demonstration of the fibres in dissection, by the thickness of the fibres corresponding with their degree of contraction, by the visible action of the human uterus during life, by the resemblance of the laws of its contraction (as felt and as perceived in its consequences), to those which govern the contraction of other hollow viscera, and lastly, by the vermicular and intestinal motions of the uterus, as seen in experiments upon brutes."

"The most curious and obviously useful part of the muscular substance of the uterus has been overlooked; I mean the muscular layer of fibres which covers the upper segment of the gravid uterus. The fibres arise from the round ligaments, and regularly diverging, spread over the fundus until they unite and form the outermost stratum of the muscular substance of the uterus."

"The substance of the gravid uterus is powerfully and distinctly muscular; but the course of the fibres is here less easily described than might be imagined. Towards the fundus the circular fibres prevail; towards the orifice the longitudinal fibres are most apparent; and, on the whole, the most general course of the fibres is from the fundus towards the orifice. This prevalence of longitudinal fibres is undoubtedly a provision for diminishing the length of the uterus, and for drawing the fundus towards the orifice. At the same time these longitudinal fibres must dilate the orifice, and draw the lower part of the womb over the head of the child.

"In making sections of the uterus while it retained its natural muscular contraction, I have been much struck in observing how entirely the blood-vessels were closed and invisible, and how open and distinct the mouths of the cut blood-vessels became

[z] "I have spoken of these points at large in my program, *De vi vitali sanguini deneganda, &c.* Gott. 1795. 4to. p. 15. sq."

[a] "See, for instance, Sue, *Mém. présentés,* vol. v.
L. Calza, *Atti dell' Acad. di Padova,* t. i. ii."

when the same portions of the substance of the uterus were distended and relaxed." "A very principal effect of the muscular action of the womb is the constringing of the numerous vessels which supply the placenta, and which must be ruptured when the placenta is separated from the womb."

"Upon inverting the uterus and brushing off the decidua, the muscular structure is very distinctly seen. The inner surface of the fundus consists of two sets of fibres, running in concentric circles round the orifices of the Fallopian tubes. These circles at their circumference unite and mingle, making an intricate tissue. Ruysch, I am inclined to believe, saw the circular fibres of one side only[b], and not adverting to the circumstance of the Fallopian tube opening in the centre of these fibres, which would have proved their lateral position, he described the muscle as seated in the centre of the fundus uteri. This structure of the inner surface of the fundus of the uterus is still adapted to the explanation of Ruysch, which was, that this produced contraction and corrugation of the surface of the uterus, which the placenta, not partaking of, the cohesion of the surface was necessarily broken.

"Further, I have observed a set of fibres of the inner surface of the uterus which are not described. They commence at the centre of the last described muscle, and having a course at first in some degree vorticose, they descend in a broad irregular band towards the orifice of the uterus. These fibres co-operating with the external muscle of the uterus, and with the general mass of fibres in the substance of it, must tend to draw down the fundus and lower segment of the uterus over the child's head.

"I have not succeeded in discovering circular fibres in the os tincæ, corresponding in place and office with the sphincter of other hollow viscera, and I am therefore inclined to believe, that, in the relaxing and opening of the orifice of the uterus, the change does not result from a relaxation of muscular fibres surrounding the orifice. Indeed, it is not reasonable to conceive that the contents of the uterus are to be retained during the nine months of gestation by the action of a sphincter muscle. The loosening of the orifice, and that softening and relaxation which precede labour, are quite unlike the yielding of a muscular ring." [c]

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[b] Discovered by Weitbrecht, and first accurately observed by Dr. Hunter.

"From the angles of the roof or fundus of the uterus arise on each side the *Fallopian tubes*[d]—narrow and tortuous canals, running in the upper part of the duplicature of the broad ligaments, similar in texture to the vagina, except that they are internally destitute of rugæ, and lined by a very soft and delicate spongy substance.

"The extremity which opens into the abdomen is not only larger than that which opens into the uterus, but is surrounded by laciniated and, as it were, digitated *fimbriæ*, peculiar and elegant in structure, that are probably of great importance in conception, since they appear to become turgid, as well as the tubes themselves, during the venereal œstrum, and to embrace the ovaria over which they lie.

"The *ovaria*, or, as they were termed previously to the time of Stenonis[e], the female testes, are composed of a tough and almost tendinous covering, and a dense and closely compacted cellular substance, which contains in each ovarium about fifteen ovula, called Graafian, viz. vesicles, or rather drops of albuminous yellowish serum, which coagulate like genuine white of egg, if the recent ovarium is plunged into boiling water."

They exceed the testes in weight and every dimension, both in man and all other mammalia.

"Such an albuminous drop appears to be the chief fluid which the female contributes in the business of conception, and it is probable that, during the adult state, these drops become mature in succession, so that they one by one force their way, and finally burst the covering of the ovarium and are received by the abdominal extremity of the Fallopian tube.

"Besides the albuminous drop which escapes from the ovarium, another fluid, improperly styled *female semen* by the ancients, is poured forth during the venereal œstrum." Blumenbach says that "its nature, source, and quantity are enveloped in no less mystery than its office."[f] It is certainly sent forth suddenly when delight is at its height; but whether it is more than common mucus may be doubted.

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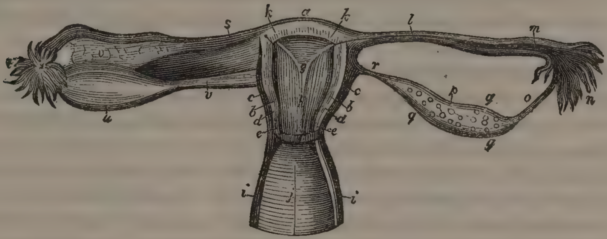
[c] *Med. Chir. Trans.* vol. iv.

[d] "Fallopius, *Observ. Anat.* p. 197."

[e] "For Stenonis was the first who asserted that the testes of women were analogous to an ovarium, in 1667. See his *Elementor. Myologiæ Specimen.* page 117. sqq."



a. Section of fundus of uterus. *b b.* Section of its anterior part. *c c.* Small portions of its external surface near its edge. *d d.* Section of the anterior part of the neck. *e e.* Section of the anterior edge of the lower opening of the neck. *f.* Posterior edge of the lower opening of the neck. *g.* Cavity and posterior wall of the uterus: up the wall is a median prominence bifurcating above towards the superior angles of the organ. *h.* Cavity of the neck. *i i.* Section of the anterior wall of the vagina. *k.* Cavity and posterior wall of the vagina. *l l.* Very fine canals traversing the angles of the uterus to become continuous with the Fallopian tubes. *m.* Cavity of the left Fallopian tube. *n.* Dilatation of this cavity near the pavilion of the tube. *o.* The pavilion slit open, and surrounded by fimbriæ. *p.* Fringe uniting the pavilion with the ovary. *q.* Left ovary completely divided longitudinally. *r r.* Vesicles in the ovarian tissue. *s.* Ligament of the ovary. *t.* Right Fallopian tube entire. *u.* Its pavilion. *v.* Right ovary. *w w.* Portion of peritoneum forming the corresponding broad ligament.

General sexual differences of form and structure are observable among but few plants; insects are the first that display them among invertebrate animals; and in some insects the difference is as complete as in the highest, and indeed the male may have not the least external resemblance to the female. General sexual differences are not unusual in the crustacea. Among vertebrate animals, the general sexual differences are slight in fish and reptiles; more evident in mammalia; and striking in birds, which in so many other respects resemble insects. In man, the difference pervades every part of the body; and, if the ovaria or testes are absent, not well developed, or removed, the sexual character is impaired, and the characteristics of the opposite sex are more or less acquired. The hair, feathers, nails, horns, claws, and canine teeth are constantly seen more abundant, larger, or more beautiful in the male brute, or seen in it only. The stature is generally lower in the female, the breadth greater, and the whole bulk less, and this even in diœcious plants; but in many classes the female is taller, and perhaps larger altogether than the male. Some male plants and brutes have odorous secretions by the skin or organs connected with it far stronger than the female, or exclusively. In some insects the male or female has certain members peculiarly shaped, or larger; or members not seen at all in the other sex. Many male insects change their skin more frequently than the female.

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[f] "Respecting this still problematical fluid see Carpus in Mundinum. P. cxcviii. sqq. and cccviii.

Harvey, *De Generatione Animal.* p. 95.

De Graaf, *De Mulierum Organis,* p. 194."

The lower orders of animals are remarkable for possessing extraordinary power of generation. The polygastric are fissiparous[g] and every part of the body is thus generative, and some also gemmiparous, and even oviparous. Porifera are gemmiparous, and each sends forth thousands of buds in a season, and lives during several. Zoophytes are gemmiparous. The freshwater polype or hydra will shoot out gemmæ or buds, which develop into new beings, and these before they are detached may develop others, and these also others; and the young will attach themselves to substances, so that when the parent moves on they may be torn away: it is fissiparous also. In the ramified horny tubular zoophytes, the gemmæ or buds are formed in vesicles which present themselves at different parts of the body. Something is seen developing itself at the bottom within, which extends upwards, drawing with it a narrow portion like a chord. This at length disappears, and the bud is developed, and moves freely by its cilia in the vesicle; and, as soon as the lid drops off from the free extremity of the capsule, the bud feels the water in which it is destined to live, and swims away, to attach itself to some hard substance and become developed into a polype. In the acalepha the seat of the buds is more determinate, being different in different species. In the echinodermata, not only is this the case, but distinct organs are seen for the production of the bud: in the asterias, two glandular and vesicular sacs in each of the radiated divisions of the body; in the echinus, five. In the lowest articulated classes, as the cystic entozoa, for instance, the cysticercus, cœnurus, and echinococcus, there is no distinction of sex, but buds are developed from their internal parietes, and, becoming detached, float loose in the parent sac. The long flat articulated tænioid entozoa and the distoma hepaticum have ovaries, but no distinction of sex. In the long cylindrical entozoa, the acanthocephalus and nematoid, the sexes are distinct, and impregnation takes place internally, as seen in the echinorhyncus and ascaris. The sexes are generally distinct in those parasites which attach themselves to the exterior of other animals, as the lernææ, chondrocanthus, achtheres; and helminthoid articulata are supposed each to contain male and female organs; but the office of what are spoken of as male organs is considered by Dr. Grant to be unknown. Cirrhopods and the highly organised annelides are all of one sex, and some of the lowest of the latter, as the stylaria paludosa, have been seen to divide transversely into several new animals. The earth-worm is hermaphrodite, and two individuals mutually impregnate each other, — thus having double joys. Gaudeant bene nati! The myriopods, arachnida, and crustacea have but one sex in each individual. Insects have not only distinction of sex, but the external characters of the two sexes are often so different that the male and female scarcely seem to belong to the same genus or even order. There is also great variety in the structure of their genitals. In regard to the mollusca, the ascidia and oyster cannot go courting, as they are settled from the moment of their birth, and therefore these acephala and many other higher mollusca which have imperfect means of locomotion, as among the gasteropoda, have no distinction of sex; — some are solely female, and some are supposed to be hermaphrodite. So with the pteropods. In the pectinibranchiate gasteropoda, comprising almost all the inhabitants of univalve, unilocular, and spiral or turbinated shells, and in cephalopods, each sex is in a distinct individual. Like cephalopods and vertebrate animals, fish, amphibia, reptiles, birds, and mammalia have distinction of sex. The male and female genital organs of animals hitherto spoken of are closed at their upper extremities, and the canal which opens externally is continuous with the most internal part. This form remains in the male in all these classes and even in man: but from the cartilaginous fishes onwards through all the vertebrata the ovary is insulated and close, and its contents have to burst through its walls to enter the oviduct. In all the vertebrata the sexual organs are double and symmetrical in early existence, but their development proceeds unequally on both sides in the females of birds and monotrema, or the existence of one oviduct is the last remnant of their unsymmetrical arrangement, so common in the invertebrata and especially in the molluscous tribes. At the early stage of existence the genitals of the two sexes in the highest vertebrata are very similar; and even at full development in the lowest, so that many fishes have been regarded by some as all females, where there probably was distinction of sex in individuals. The two sexes of fish not only resemble each other closely in their genitals, but also in the rest of their body, as in higher vertebrate animals before puberty, just as though they were invertebrate animals in which there is no distinction of sexual organs and therefore the rest of the body of all is alike. In the highest cartilaginous fish, — the reptile form of fish, — rays and sharks, a marked external and internal sexual difference begins. The females are larger, and the males have more beauty and variety of colour. The sexual functions of fish, as of inferior tribes, is more subjected to the influence of season, and they have fewer instincts in regard to their future progeny than the higher classes. In the osseous fishes, in which the structure of the sexual organ is the most simple, there is no sexual intercourse, but the male impregnates the ova after their separation from the female. They are usually discharged all at once in a mass. In viviparous kinds, as in almost all animals in which impregnation takes place internally, the ova are developed successively; and the young are often very large before by a strong action of their tails they burst the outer membrane of the ovary, which, as in higher animals, communicates by a small opening with the small intestine. The females of the oviparous proceed, without impregnation, in order to spawn in places suited to their ova and the young, at their season of generation, "often in vast shoals to a different climate, or to the shallow shores of the sea, or ascend estuaries and overleap cataracts," while the males follow them to impregnate the discharged ova. The parents "leave to nature the development and rearing of the embryos and young, attached by their glutinous exterior to rocks or plants. In the syngnothus the ova are received from the anus into a long external abdominal pouch, formed by two lateral folds of the skin, in which they are hatched, like the ova attached to the false feet under the post abdomen of a lobster, or like the young in the abdominal pouch of a marsupial quadruped, or in the dorsal cells" of a pipa. "The male of the Surinam toad — bufo dorsiger spreads the newly discharged ova over the rough back of the female, and there impregnates them, exposed upon the surface and adhering. The female betakes herself to the water, and the skin of the back, at first without cavities, extends over them in the form of open cells, where not only the ova are hatched, but where the young remain till they have passed through their metamorphosis, lost their gills, acquired feet, and are ready to accompany their parent to her wonted dungeons and solitary haunts. The male of the little bufo obstreticans assists in extricating the large ova from its mate, impregnates them, and fixes them in clusters by glutinous filaments to its own thighs. It thus retains the developing ova till near the period of their hatching, when it betakes itself to the water; the ova burst, and the male parent, cleared of its burden, seeks its accustomed rocky retreats."

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[g] See Spallanzani's admirable *Observations et Expériences sur les Animalcules.* He found a small portion detach itself from the bodies of some, the bodies of others split longitudinally, of others transversely, of others both longitudinally and transversely into four parts; and the new animalcules soon acquired the size of the parent and experienced the same changes in their turn. See also the account of the planaria, p. 254. supra. Division and growth proceed so rapidly in the polygastrica, that one individual has been computed to be able to give origin to a million in seven days.

Like the highest cartilaginous fish,—rays and sharks, the amphibia have a local and general sexual distinction, and their ovaries are distinct and unconnected with the oviducts. Their sexual distinctions are often increased at the breeding season. "The longitudinal dorsal serrated crest of the male tritons, and the hands of many of the male frogs, undergo a considerable change in size and form, corresponding with the periodical changes in the generative organs within, and we observe the same kind of changes produced periodically in the external dorsal cells of the female pipa. Sometimes the whole anterior extremities of the male frogs enlarge at the breeding season, and the external colours become more lively, as in the sides of the finny tribes in the season of procreation." Their generative organs are symmetrical on the two sides of their body, and have extraordinary fertility. In regard to frogs "the ova, seized by the wide infundibula of the oviducts, imbibe through their chorion, a transparent gelatinous secretion as they pass through their canals, which envelops the whole yolk, and which swells to a great size by absorbing water when the ova are discharged from the body into that medium." "The testicles, and the whole of the genital parts of the male, swell at the breeding season, like those of the female; and the male frogs, which are smaller than the female, leap upon their back, and, embracing their abdomen firmly with their enlarged tuberculated wrists, remain in that situation several weeks. The females betake themselves with their burden to the water, where from the density of that element the weight they support is diminished, and where they are excited to the expulsion of the ova and assisted in that process by the pressure of the adhering and embracing arms of the male. As the ova are expelled, they are impregnated externally by the effusion of the seminal fluid from the cloaca of the male, without the aid of an organ of intromission, as in the lowest oviparous fishes." The small number which are not devoured by other animals are developed much like those of osseous fishes, and are burst by the action of the black uncoiling tail of the embryo. As the lowest animals are exposed incessantly to causes of destruction, without the means of foresight or escape, they produce in myriads, a large portion of which perish before they arrive at maturity. In proportion as animals have more intelligence and more means of defence, by possessing a higher organisation, the number of progeny is diminished, and the young are retained longer in connection with the body of the parent. "The internal mode of impregnation, and consequently the internal development of the embryo, to a variable extent, becomes a normal character, from the ophidian reptiles through all the higher orders of vertebrata. By the gradual development and ascendancy of the organs of excitement, and the consequent increased connection of pleasure with the generative function, it becomes more subject to the will and feelings of animals, less regulated by the seasons, less influential in the economy, and more precise and limited in its results. The male fluid is no longer thrown indiscriminately over myriads of ova already discharged and detached from the body of the female, but is conveyed, with great precision, by the activity of the villous surface of the oviducts, to excite a limited number of ova, and commence the development of the young while yet within the body of the parent. Purkinje and Valentin say that they have seen vibratory cilia in rapid action in the living mucous membrane of the oviducts and Fallopian tubes of reptiles, birds, and mammalia, and also on the mucous lining of the lungs for half an hour after death, by viewing the detached membrane in water under the microscope." In the ophidian reptiles the sexes are distinct, the sexual organs are double and symmetrical, though very similar in their permanent form and situation in each sex, the external differences of the sex are not well marked, and impregnation takes place internally. The male and female serpents in their amours "dart their tongues, rub their necks and their glittering skins together, twine their bodies round each other, roll upon the ground, and bring their ani into contact." The ova arrive at different degrees of development in the oviduct, and are often hatched there, but are generally deposited in the ground under bushes, long grass, or stones, or in the cavities of decayed trees; and the rearing of the young is left to nature. Geoffrey found that, if common snakes were kept in water, the ova remained in the ducts till they were hatched, so that the animal could be made viviparous or oviparous at pleasure. The male organ is generally double, bifurcated, and covered with recurved stiff spines at its lower extremity; each half has a bifurcated glans in boas and pythons. The male and female organs of the saurian reptiles agree in general with those of the ophidia. The penis of crocodilian sauria is an imperfectly divided corpus cavernosum, grooved below, and forming a tube by the meeting of its sides during erection. The penis of the lacertine, iguanian, and sincoid sauria is double throughout. The ova are hatched out of the body by the heat of the climate which they inhabit. Some are viviparous, as the Seps, which is almost a serpent. The eggs of the iguana of South America are large, and consist chiefly of yelk, and are used as articles of food. The alligator of Guiana deposits about sixty in the loose grass, covers them with dried leaves or stones, and defends them boldly when they are attacked. The alligators bellow like oxen in the season of love. Their eggs, too, are used in Carolina as food. The crocodiles of the Nile copulate lying on their sides;

the males fight fiercely for the females, which are in smaller number; and the females deposit eggs larger than those of a swan, twenty together, three times, after short intervals, in cavities dug in the sand with their muzzles, watch and assist the escape of the young, defend them from the males which are very fond of eating them up, and even feed them, some say, from their crops like pigeons. The chelonian reptiles differ in no point of generation remarkably from the saurian and ophidian, and, like them and others in which the approach of the sexual organ is rather difficult, have the penis disproportionately long. The penis has a double corpus cavernosum, the lower median groove of which forms a canal by the meeting of the sides, as in crocodiles, during erection.

Birds, like insects, have high mental endowments, and far more than mere sexual desire. "They select a safe retreat, most carefully construct their nests, watch over the products of generation with parental care, and provide for the difficulties and dangers which attend the helpless condition of the young." Yet the condition of the generative organs is scarcely higher than that of the lowest reptile which throws its eggs into the water and leaves them for ever; for the eggs are developed out of the body. As these are hatched by the close contact of the maternal abdomen, they require a strong shell, which must at the same time be brittle for the escape of the young. The existence of two oviducts sufficient for their safe transmission would be impossible; and hence one set of genital organs (the right ovary and oviduct) atrophies, while the left increases. Even when the testes are of different sizes, the right is the smaller, showing the existence of a law prevailing in both sexes, though less powerful in the male. "The cock, like the male frog, leaps upon the back of the female, seizes her head with his beak, fans her with his wings, and pushes her tail to one side, and, when the ani are juxtaposed, the male fluid, or the male influence, is hurried on by the active lining of the oviduct to impregnate at once numerous developed ova, which descend in slow succession through the open elastic pelvis to be hatched externally." The seminal vessels end in two papillæ in the cloaca, which correspond with the double penis so common in serpents and reptiles. The unimpregnated female can periodically discharge crops of ova, as the sexless coral does its gemmules; but their development requires the male influence. The testes, as in all the vertebrata hitherto spoken of, and the inferior mammalia, lie within.

In the mammalia not only is each sex found in a different individual, but usually the general distinction of the two is pervading and intense, the sexual organs double and complicated, and one or both parents occupy themselves with the care of the young after their disclosure from the mother. The ovaries are comparatively far smaller than those of the lower classes, and contain but few ova. The oviducts, still distinct from the ovarium, as in all the vertebrate tribes hitherto mentioned above the osseous fishes, continue also distinct from each other, as in these, through their whole course, in some of the inferior mammalia, — as the marsupialia, monotrema, and rodentia, so that these are said to have a divided uterus. In the higher, they are united; and, if so at their lower part only, the uterus formed by them is said to be horned, as in ruminating and most other herbivorous animals, and in some carnivora; and, if they are united to a higher point, we have the triangular uterus of the quadrumana or the more pyriform human uterus. The females have a clitoris for excitement, but it is small: single in the highest; divided in those animals which have the penis bifid, and supplied with a bone, when the penis has one. Its presence is much more constant than in reptiles and birds, as well as its development greater.

" The openings of the female urinary and genital organs are as close in the monotrema, and nearly as close in the marsupials, as in oviparous vertebrata; but, as we ascend, we find the openings more separate. The cloaca, or cavity receiving the opening of the digestive, urinary, and genital organs in oviparous vertebrata, is in mammalia divided by the descent of the rectal vestibula, so that it opens by a true anus; and the urethro-sexual canal is separated from the rectal, as we ascend from the monotrema, and the rodentia and edentata, through the higher order of quadrupeds. The original abdominal situation of the testes of the higher mammalia and man" is permanently " preserved in many of the lowest mammalia, as in the cetacea and the monotrema; in others they descend, guided by the gubernaculum testis, to a variable extent, towards the abdominal ring, as in the seals and the walrus; in others they pass out through the abdominal ring only at the rutting season, to swell externally, and afterwards in their more collapsed state to be returned into the abdomen, as in numerous genera of burrowing rodentia; and in most of the higher order of mammalia, as in the carnivorous cheiroptera, quadrumana, and man, they pass down early into an inguinal scrotal cavity, and remain permanently external to the abdominal cavity. They come down earliest into this region in man." The epididymis and vasa efferentia enlarge in inferior mammalia during the season of generation, which is more regular and periodical than in the higher tribes. The vesiculæ seminales are very irregular in their form and inconstant in their existence, being large reservoirs in many of the lowest quadrupeds, as the rodentia and pachydermata, and the higher orders of cheiroptera, quadrumana, and man, and absent in many intermediate animals among the ruminantia, the monotrema, marsupialia, and carnivora. Cowper's glands are larger and more subdivided than in man. The prostate is commonly double, composed of many large branched follicles, and more constant than the vesiculæ. The glans penis has often recurvated horny spines, as in reptiles, to fix it during long copulation, and the same animals have frequently a bone in the penis to support the urethra.

" The penis is still spiny and bifid, and lodged in the cloaca in the ornithorynchus, as in reptiles; it is bifid in many marsupialia, concealed in the cloaca in some rodentia, very large and concealed beneath the exterior parietes of the abdomen in the cetacea, suspended along the abdomen in the herbivorous and carnivorous quadrupeds, and hangs free in the cheiroptera and quadrumana, as in man." The ovum, having escaped from the ovary, attaches itself by one or more points to the interior of the uterus, where it is matured to a variable extent in different orders, is hatched in the act of expulsion, " naked, feeble, and helpless," at its birth, and it requires suckling and parental tending. The situation of the breasts varies according to the facility of sucking; and the number of the nipples correspond with the number of young usually produced by the animal,—ordinarily two when the breasts are thoracic; they may have a single opening as in the ruminants, or many as in most of the mammalia. — (See Dr. Grant's Lectures in *The Lancet*, No. 590. 593. 597.)

The following is a general anatomical view of the grades of the organs of generation in animals, compiled from Burdach: —

The ovarium may be a single tube, closed at its inner extremity and open at the outer: and the ovum is produced at the closed end, and passes on to the outer, becoming more perfect as it proceeds. A fluid is secreted into this blind canal, as into the ducts of glands, condenses, and becomes an ovum on the free surface. There may be many such tubes, opening into a common excretory duct; or this may be of great size and take a different direction, so that the tubes appear as branches and it the stem. If these are bound together by cellular membrane, they have the appearance of a gland.

The ovarium may be cellular, and the fluid of the ova be secreted into close cells, the walls of which it bursts as it advances to maturity. These cells may be merely spaces in the tissues or be cavities of distinct vesicles, — the cellular ovary may be interstitial or vesicular. The cavity of the interstitial is produced solely by the fluid secreted in the tissue taking the form of an ovum in it and thus producing a cavity, from which in a certain time it bursts: in some cases there is a cavity for it to burst into, and this cavity may serve as a receptacle and conductor, or as a receptacle only. These are are successively higher grades, and in some fish, chelonian reptiles, birds, and the mammalia, the highest form of ovarium is found, — the vesicular — a collection of vesicles in a modified cellular substance, covered by peritonæum, and, in the mammalia, invested, beneath the peritonæum, with a peculiar coat, called albuginea. Each vesicle has a semitransparent external coat of cellular membrane, and a thicker, less transparent, and softer internal, with fine granules on its inner surface.

The product of the ovarium, or ovum, is in vegetables termed the seed. At first it is a cellular excrescence, below which are several tracheæ, and, lengthening more and more, its bore contracting at the same time and becoming a peduncle, ultimately forms the umbilical chord. At the same time, three parts become distinct — an external membrane — *testa*; an internal — *tegumen*; and the *nucleus*; placed one within the other, but touching at their base only — the chalaza. The summit of the nucleus projects through an opening, termed *micropyle*, in the two membranes. At this summit fecundation occurs when it comes in contact with a point in the inner wall of the ovary where a chord terminates. In the nucleus a cavity now takes place, which increases, and in which the embryo forms.

The animal ovum is produced from the partial condensation of the liquid secreted in the ovum; which liquid is called the *embryotrophe*, as nourishing the embryo, and forms both the coverings of the ovum and the embryo itself. The embryotrophe is the yelk, usually yellow, and contains more or less albumen and fatty oil. In many animals, a white nutritive substance, called the white, is added to it in concentric layers. The covering of the ovum, produced by the condensation of the external part of the embryotrophe, resembles cuticle, and is not an obstacle to the penetration of the fluids of the ovarium or testicle, or of their influence. The *germ* is composed of two parts, — the one a mass of granulations on the surface of the yelk, — *stratum proligerum*; the other a vesicle — *vesicula proligera*, and situated in or below the stratum; both which become confounded during fecundation or the exit of the ovum from the ovarium, so that the stratum only exists and becomes the embryo. Baer discovered the ovum in the ovarian vesicle of the mammalia, in regard to which it previously was supposed not to be formed in the fluid of the vesicle till after this had burst. The ovum of oviparous animals abundantly absorbs the fluid of the ovarian vesicle, so that its exterior is almost closely applied to the latter; whereas, in mammalia, the ovum absorbs the ovarian fluid in very small quantity, whence this accumulates, and distends the vesicle to from fifteen to fifty times a greater size than the ovum, which is one 20,000th part of the bulk of the mother, in woman.

The testicle has various grades, like the ovarium. It may be tubular or glandular: the former showing its tubular form externally, and consisting of a simple tube or branches; the latter having its canals aggregated into a mass.

In vegetables, the semen, or contents of the grains of the pollen, is called *fovilla*, and is a mucilaginous liquid, mixed with drops of oil and grains of starch, and inflammable. Its chief part is pollenine — a white and light inflammable powder, insoluble in water, alcohol, ether, oils, and alcalies. It has been lately found by M. Meyer of Berlin to contain entozoa.

The ovarium and testis have many parts of comparison and contrast. The ovary is the original organ of generation, and the testis is added in higher systems only. Their purpose is the same: the elementary form of each in the lowest scale of animals is tubular; and the testis remains tubular, though its tubes are, in the higher animals, conglomerated into a mass. They are each as generally double or symmetrical in animals. The higher the point in the scale, the less is the resemblance, as the ovarium undergoes a regular progression, which does not take place with the testicle. The globular form indicates completion, — an action confined to itself, and is found in the ovary; the lengthened shape of the testis indicates an action in relation to something external: the highest kind of ovarium is close; the testis always opens externally: and the ovarium, even in vegetables, is the more internal or central organ: in almost all animals, — in all, except some which have it in the lowest degree of development, it is situated in the abdomen. In some mammalia the testis is outside the abdomen, except during the season of heat; in the higher mammalia, after having once quitted the abdomen, it never re-enters; and in man only is it made completely extra-abdominal, by the complete cohesion of the portion of peritonæum between the testis and the abdominal ring.

The median organs of generation are those which stand between the producing and the discharging organs. The female median organs, or oviducts as they are termed, whether spores or ova are transmitted, are not found in vegetables, nor in some of the lower animals which produce spores, nor in others which produce ova, as the medusæ, asteriæ, some annelidæ, and some fish and reptiles: while others of the lower animals, that even propagate by spores, have them. The oviduct of the inferior animals is a continuation of the ovarium, and is its excretory duct: but, in those of them whose tubular ovaria form sinuses in which the ova are produced, the oviduct portion is distinguishable by its freedom from sinuses and by the smoothness of its internal surface.

In higher animals, as all reptiles, birds, and mammalia, and a few fish, the oviduct is detached, and an extremity of a funnel shape lies close to the ovarium; but it is detached in vertebrate animals only. The oviduct may be homogeneous, or may be heterogeneous — have a distinction of parts. If homogeneous, whether continuous with, or detached from, the ovarium, it may be solitary or compound. The functions of the oviduct are motion — transmission; and formation, on the accession of an impregnating fluid, furnished by itself or from without, or of a fluid to nourish and complete the ova. In many animals ther organs are added to the oviducts, as particular vesicles, cylindrical tubes, or glandular tissues, and appear to constitute an inferior formation; indeed they may be partial rudiments of uterus. None of them exist in the mammalia; and their median organs are heterogeneous, are the oviducts and womb, or a reservoir attached to the outer extremity of the oviduct. When the oviduct is of a certain size, and acquires the character of mucous membrane, a muscular coat and a fold of peritonæum, it also acquires the form of the digestive tube, being narrow at one part like the œsophagus or intestine, and broad at another like the stomach or cæcum. This resemblance is observable in most mammalia, but chiefly in marsupial animals. In quadrumana and edentata, the walls of the dilated portion or womb are thicker than in any other mammalia, but infinitely less thick than in woman, in whom only it loses all resemblance to intestine, and acquires a peculiar structure, solid, resisting, spongy, and has a greater thickness than in any other animal. In some lower mammalia, a portion of peritonæum runs between the ovarium and the beginning of the oviduct, establishing a sort of cavity, in which these lie opposite to each other; and here the horns of the uterus can hardly be distinguished from the oviducts. The muscular fibres of the uterus of most mammalian brutes are stronger than in women, and have a peristaltic motion. Before we arrive at a single uterus, we observe the ends of the oviducts of marsupial animals dilated into wombs (*uterus multifidus*), which are not united into one organ; there is a straight central body, and at each side a curved canal, with one end opening into the base of the central cavity, the other into the vagina. The vagina itself is two in the kangaroo. The uterus may be thus double (*u. duplex*), and the vagina single, as in most rodentia; or it may be double and have but one external opening (*u. bicollis*); or it may be one cavity at its neck, and divided above, as is peculiar to ruminants (*u. bicorporeus*); it may be single except at its fundus, which is prolonged into horns (*u. bicornis simplex*); it may be single except at the very terminations of the oviducts (*u. biangularis*). If the organ is perfectly single in some edentata and quadrumana, still it is more elongated in all, and less decidedly distinguished from the oviducts and vagina, than in woman, in whom elongation remains to the oviduct only, which has no other office in her than that of transmission.

Fish with vesicular testes are the only animals that have no organs for the emission of semen. The vas deferens may be single, and then have one cavity, as in hermaphrodite mollusca and digenous gasteropoda; or be divided into two, as in cephalopoda; or it may be double, even when there is but one testis. When the testis is double, the vasa deferentia may unite into one; either really, as in fish, or only in external appearance, as in the bear, &c.: or they may remain double, as in all mammalia, as well as in birds, reptiles, &c. In many animals, they have dilatations here and there. Various accessory parts, in the form of vesicles chiefly, are found connected with the vas deferens in different animals. In mammalia, vesiculæ seminales are never found without the prostate and Cowper's glands. In the hedgehog and rabbit, they open separately from the vasa deferentia; — muscular fibres are supplied to them in the larger brutes, and they have often been seen to move on the application of various stimulants.

The median organs of the two sexes agree in being conductors — in beginning by a large portion,—the oviduct by the pavilion or funnel-like expansion, the vas deferens by the epididymis.

In woman the median organs — the oviduct and uterus, are more developed, and more peculiar in structure, than the internal or external; in man the internal and external — the testes and penis more than the median. The lower degree of the median male organ is shown by the vas deferens being continuous with the testicle, while the oviduct is distinct from the ovaries; by the median male organs at their highest development possessing appendages, while the median female organs lose them at the highest. The median male organs serve merely to conduct, and that in but one direction; the female to conduct and develop or form, and to conduct in two directions. The purely conducting part, — the oviduct, is therefore much shorter absolutely than the male corresponding part — the vas deferens; and shorter relatively to the uterus than the vas deferens to the vesiculæ seminales; while the reservoir, the uterus, is of very great size. The uterus being the predominant part has a round ligament, while the testis has its gubernaculum, converted indeed into cremaster and cellular envelope. The lower we descend among animals, the less difference do we observe between the median male and female organs, and the greater analogy indeed of both to the other organs of the system.

The oviducts sometimes terminate externally near the solitary common elementary opening, as in the rotifera, some polypes, and acephala; or near the mouth, as in the holothuria; or near the anus, as in some acephala, gasteropoda, and most fishes; or in the lower surface near to the mouth or anus, as in the earth-worm, leech, ascaris, and strongylus. Sometimes they open in connection with other organs; — with the digestive, as in some polypes, and in the actinia, in which they open into the upper part of the alimentary canal; with the respiratory, as in the ascidia, in which they end in the branchial sac; with the urinary organs, as in the tortoise, in which they end in the neck of the bladder. Sometimes they have a common opening with the digestive and urinary organs, termed cloaca, as in most insects, and in birds. The female genitals terminate in a distinct and proper external apparatus in mammalia only. The vagina has muscular fibres, both longitudinal and transverse in brutes; but its mucous membrane has far less rugæ than in woman. Its length bears a greater proportion to that of the uterus, and greater accordingly as the perfection of development is less: and in the same proportion is it less separated from the uterus by a projecting opening. It has the same direction as the uterus; lies below the rectum; and, in those lower mammalia whose uterus is double, it sometimes also is double.

Fish and birds have a clitoris, though destitute of vagina; and, the lower the mammal brute, the more does the clitoris resemble the penis. In marsupials, tardigrada, and the ornithorhyncus, all which have a bifid penis, the clitoris is bifid; and in the bear, raton, lion, cat, and most rodentia, it has a bone, as well as the penis. It approaches more to the size of the penis in the cetacea, most marsupials, rodentia, carnivora, and quadrumana, in the latter of which its length at least equals that of the penis. In some it still more resembles the penis in having the urethra more or less connected with it: — this opens at its base in the agouti; the urine running along a semicanal in the ostrich, &c.; or the urethra being contained in it in the maki and lori.

The nymphæ exist in but few mammalia; such as the elephant, lion, and porcupine.

In insects, arachnida, and crustacea, valvuliform parts are found around the external orifice of the female organs: but birds are the first animals in which any thing like labia are found.

The vasa deferentia may terminate externally by a simple opening, which may be applied to the female opening, or to the eggs after their discharge; or it may terminate in a penis to be introduced into the female organ. The simple opening is, however, prominent and supplied with caruncles. It may lie on the surface, as in mollusca, crustacea, arachnida, and some fish; while in others it opens in common with the urethra, or in the cloaca, or upon or projecting from the cloaca, as in many reptiles and birds.

In some animals, the penis is imperforate and serves merely to excite and delight the female, as in the earth-worm, crab, and some others. It may have a groove to direct the semen, as in hermaphrodite mollusca and some reptiles.

The perforated penis is sometimes lodged in a cavity, sometimes only in a sheath. It may leave its cavity by retroversion, the inner portion pushing forward the outer, as the finger of an introsuscepted glove may be pulled out, or by elongation. Retroversion occurs in some mollusca, the crab, the bee; and the cavity may be the common genital or a respiratory cavity as in the first, or a peculiar one as in the last two. The free perforated penis occupies various cavities, but never the common genital nor the respiratory; — the rectum, or a cavity common to it and the anus, in the ascaris lumbricoides; or a tubular cloaca, that is an union of ureter and rectum, as in the seal and beaver; or a cavity proper to itself, as in some hermaphrodite mollusca.

The penis, which is always external, and seems to have brought its cavity out with it, and to have converted it into the sheath called prepuce, is seen in mammalia only. In carnivora, ruminants, pachydermata, solipeda, amphibia, and cetacea, it is only the half of a cylinder, and, this being fixed to the abdomen, the tube is completed by the abdominal integuments. In the cheiroptera and quadrumana it is a complete tube, and the penis is always detached from the trunk, hanging below the pubes.

The external organs of generation are the more different the higher the station of the animal. In the lowest, sexual distinction is impossible externally. The vasa deferentia end in mere orifices: then they are prolonged in the form of a hollow cylinder, resembling a vagina, but which being free on its surface is capable of eversion and becoming a penis; then we have a penis, which is a vagina constantly everted, but remaining in a cavity except at the moment of generation; and then the penis of most mammalia, situated externally in a sheath: and lastly, that of quadrumana and man. In the lower again, the female organs end in projecting papillæ, as in crabs and spiders: then we have a clitoris, with crura as long again as the stem. When there are many organs they become connected with the external genitals. In the gasteropoda, the ureter opens into the oviducts and the vasa deferentia. Ejection being the characteristic of the male, the connection is most striking in him: both systems have a common orifice in cartilaginous fishes: and, in the human subject, the urinary receives the genital conduit in the male, while the genital receives the urinary in the female. The urethra has a tendency to be enveloped by a corpus cavernosum in the female; as the urethra, however, does not form a free cylinder, but ends in a cavity, this cellular body can extend itself only on the wall of the cavity in a split form like the rudiment of the corpus cavernosum of the penis of birds, which thus forms the nymphæ, and extends to the clitoris only without giving it a glans. What is the bulbo-cavernosus in the male is the constrictor vaginæ in the female. The hymen, which limits the portion of the genital organs free from union with the urinary, has its parallel in a small cutaneous fold situated at the extremity of the vasa deferentia. What is scrotum in the male is labia in the female; and it is split like labia in many rodentia, and has no hairs on its inner surface.

In vegetables the sexual organs do not appear till the plant is perfect, and they fall off when they have performed their function a single time. In the lower animals the sporcyst, which is the first rudiment of generation, is cast off and reproduced. When sex exists, the product of the organs of generation may be frequently renewed, as in lower animals having but one cavity for the formation and elimination of the ova: while, in the male, semen may be secreted at seasons only; and in man only does this its secretion and discharge continue all the year round. In a middle degree, when the ovary has a cavity distinct from that in which its functions are accomplished (the hollow interstitial ovary), or no cavity nor oviducts (full interstitial ovary), the very parts which produce the ovaries are renewed, for the cells are not permanent. In the most perfect form the ovaries produce but once, the number of cells being originally fixed, and each cell furnishing but one ovum. Five hundred have been counted in the fowl; sixteen to twenty-four in the sheep; while from fifteen to thirty exist in a woman. In the ovary of middle degree, many ova are usually formed and expelled at once; in the perfect kind of ovum, either one only is matured at once, or not at any rate more than twenty. Yet, even in the former case, if ova are discharged but once during life, the ova within the ovary differ in size, as though the earliest, after a certain time, had been arrested, and made to wait for the later ones; and, if several discharges take place during life, still, besides the ova ready for a discharge, a second, and even a third, series of minute ova may be detected for future discharge.

If a vegetable has evident organs of generation, these may be in the same flower or not. If in the same flower, the male organs may become erect and incline towards the female: or the female may approach the male: or both may approach each other. If in different flowers, the male impregnating matter may be conveyed to the female organ by the wind, insects, &c.

CHAP. XXXI.

THE MENSTRUA.

"An important, and indeed the most frequent, function of the uterus, during about thirty years[a], is to afford monthly discharges, termed catamenia in Greek, menstrua or menses in Latin, and courses in English, — a law imposed upon no other species of animal[b]: — Woman, in the words of Pliny, is the only menstruating animal. The females of no nation, hitherto explored, are exempt from this law[c], since it is among the requisites in the female sex for the propagation of the species.

"The commencement of this function usually occurs," in this climate, "about the fifteenth year," and more frequently earlier than later, "preceded by symptoms of plethora, by a sense of heaviness in the chest, and of tension in the loins, by lassitude of the limbs, &c." All the vessels of both the internal and external genitals become turgid, whence all the parts are fuller, redder, softer, and warmer, and the uterus even descends a little. "At first a reddish fluid generally flows from the genitals, becoming by degrees of a more bloody colour, and at length completely so. This has a peculiar odour, coagulates but imperfectly, and differs also in other respects from blood. It continues to flow slowly for some days, and the unpleasant symptoms above described cease in the mean time," the discharge becoming at length paler and less abundant. Often the breasts feel full and uneasy, general feverishness occurs, and existing diseases are augmented. The eyes are often dull, surrounded by a dark circle, and the skin may have a peculiar odour, and the temper be irritable.

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[a] "Consult, besides many others, F. C. Nägele, *Erfahrungen über Krankh. des weibl. Geschlechts.* Manheim. 1812. 8vo. p. 265."

[b] "Most writers upon Natural History, and among the rest Buffon, allow the existence of a periodical discharge of this kind in some other animals, especially in certain simiæ. But, after carefully observing the females of the species of simiæ mentioned by him, (*v. c.* of the simia *sylvanus*, and *cynomolgus*, the papio *maimon*, &c.) for a number of years, I easily discovered that these supposed catamenia in some did not occur at all, and in others, of the very same species, were merely a vague and sparing uterine hemorrhage, *observing no regular period.*"

[c] "There is hardly occasion at present to refute the unfounded assertion, that in some countries, particularly on the continent of America, the women do not menstruate. This opinion appears to have originated from the circumstance of the Europeans, who visited those countries, and saw innumerable women nearly naked, never observing any menstrual stains upon them. For this there might be two reasons. First, the American women are, by a happy prejudice, regarded as infectious while menstruating, and retire from society into solitary huts, to the benefit of their health. Secondly, their extreme cleanliness, and the modest position in which they place their limbs, would prevent any vestige of the catamenia from being observable, as Adr. Van Berkel expressly states, *Reisen nach Rio de Berbice und Surinam*, p. 46."

"This red discharge returns afterwards about every four weeks, and continues about six days, during which time a healthy woman is supposed to lose, perhaps, from five ounces to half a pound of blood." Some women menstruate but two days; some ten: some, whatever the period, moderately; some immoderately. Some menstruate every three weeks; some every five. All peculiarities of the function may be hereditary, like every point of function or structure in the uterus and every other organ. The quantity is usually commensurate with the warmth of the climate.

"This action is usually *suspended* during pregnancy or suckling.

"It entirely *ceases* after existing about thirty years; and, consequently, in our climate, about the forty-fifth year of age."[d] I have known some menstruate after fifty: some menstruate after the function had ceased at the usual period, and been absent for many, in one case for even ten, years. But in such cases there often is pain at the time, and ultimately uterine disease.

"By some, the vagina, by others, and with more probability, the uterus, is considered the *source* of this discharge. Instances of women menstruating although pregnant, or having the uterus imperforate, or inverted and prolapsed, do not favour the former opinion, but prove only the extraordinary compensating powers of nature, who successfully employs new ways, when the usual one is obstructed. On the other hand, the dissection of many women who have died during menstruation has discovered the cavity of the uterus bedewed with the catamenia.[e] We say nothing of the à priori argument — that the purpose of menstruation is probably to render the womb fit for pregnancy and for nourishing the fœtus."[f] Still the vagina may furnish the discharge occasionally, as when women menstruate during pregnancy after the neck of the womb has become distended.

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[d] "H. Helm. Spitta, *Commentatio præmio Regio ornata, sistens mutationes in organismo et œconomia fœminarum cessante fluxus menstrui periodo.* Gotting. 1818. 4to."

"The investigation of the *causes* of the periodical return of this hemorrhage is so difficult, that we can obtain nothing beyond probability, and must not dare to offer any thing merely conjectural."[g] It is usually more abundant in proportion to the general plethora and local excitement: most abundant, therefore, in highly fed and indolent women; and often very abundant in newly married wives. The power of local disposition is shown in the facts of venesection not in general preventing the discharge more than any thing else equally disturbing the whole system; and of the discharge stopping sometimes in plethoric women, and continuing freely in the most spare. We sometimes witness a periodical discharge from the aërial or alimentary passages, or from an ulcer, or even from the urinary mucous membrane, that of the eye or ear, from the breasts, or even from the sound skin, and chiefly then from the umbilicus or fingers.

"The proximate cause is supposed to be a *local*[h] plethoric congestion, — an opinion with which the symptoms preceding menstruation, and the abundance and nature of the uterine vessels, agree very well."

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[e] "See, for example, Morgagni, *Adv. Anat.* 1. tab. iii. M.M.M." I have seen this frequently. It proceeds through the sides of the capillaries, like any secretion, and, being dark and venous, must be furnished by them near their conversion to veins.

[f] "L. H. Chr. Niemeyer, *De menstruationis fine et usu.* Gott. 1796. 8vo."

[g] "Those who feel interested in this inquiry may consult, among other writers, Abr. D'Orville, *Disquisitio* (Præs. Haller), *causæ menstruii fluxus.* Gotting. 1748. 4to.

Gisb. Verz. Muilman, *An ex celebrata hactenus opinione de plethora universali vel particulari vera fluxus menstrui causa explicari possit?* LB. 1772. 4to.

Theod. Traug. Jaehkel (Præs. Krause), *Aetiologia fluxus menstrui.* Lips. 1784. 4to."

[h] "The *universal* plethoric orgasm, as it was termed, which some formerly regarded as the cause of menstruation, has been long since refuted by more enlightened physiologists. To the arguments of the latter we may be permitted to add the instance of the celebrated Hungarian sisters (described in Buffon) who, from monstrous formation, were united together. Although the same blood flowed in each, on account of the union of the abdominal blood-vessels at the

I have known some women bear children before they had ever menstruated, and others after menstruation had entirely ceased. Many authors relate instances of women being mothers without ever menstruating. Dr. Foderé attended a woman who had menstruated but once, and that in her seventeenth year, although thirty-five years of age, very healthy, and the mother of five children.[i] Morgagni mentions a mother and daughter who both were mothers before menstruation. De la Motte saw cases of this kind.[k] Sir Everard Home mentions a young woman who did not menstruate till after her pregnancy.[l] Dr. Merriman mentions that he attended a lady who had not menstruated for a year and a half previous to her delivery.[m]

Neither is the pleasure of coition requisite to impregnation; for the mother of one of Napoleon's generals, as well as of other children, told a friend of mine, "Qu'elle n'avoit eu que le douleur d'enfanter;" and the late Dr. Heberden has the following passage: — "Duo mariti mihi narrarunt uxores suas in venerem fuisse frigidas, omni ejus cupiditate et voluptate carentes; sæpe tamen gravidas factas esse, et recte peperisse."[n] Gall has known similar cases.[o] There can therefore be no reason why a woman should not be impregnated while asleep, if it is possible for her not to be roused. In a preternaturally sound sleep this appears to have been accomplished.[p] Dr. Brachet mentions two paraplegic women, without the least sensation in the vagina, who, notwithstanding this, were impregnated, and went their full time.

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loins, they differed frequently both in the period and the quantity of their menstruation."

[i] *Médecine Légale,* t. i. p. 393. A case is mentioned of a woman who had three sons, and never menstruated, nor had lochia. *Ephem. Natur. Curios.* Dec. ii. ann. 1. p. 114. sq.

[k] *Traité complet des Accouchemens,* p. 53.

[l] *Phil. Trans.* 1812. p. 11.

[m] *Med. Chir. Trans.* t. xiii. p. 347.

[n] *Commentarii de morborum historia et curatione,* cap. 43.

[o] *Sur les Fonctions du Cerveau,* t. iii. p. 253.

[p] See the *Causes Célébres* (Foderé, l. c. t. i. p. 500. sq.) for an account of a priest and what he thought a dead body.

He divided the limbar portion of the spinal chord in a bitch, put her to the male, and found her impregnated.[q]

Many women menstruate during the first five months of pregnancy. Dr. Heberden mentions one who always menstruated the whole nine: she had lain in four times. Mr. Mayo was informed by a woman that this had been her case in each of seven pregnancies.[r]

Women sometimes menstruate during suckling; but, when this happens, it is not generally till two or three months have elapsed after delivery. The milk is often vitiated in these cases, and deranges the alimentary canal of the infant.

The reason that menstrual blood does not coagulate is its deficiency of fibrin: it is, therefore, really not blood. "It has the properties," says Mr. Brande, "of a very concentrated solution of the colouring matter of the blood in a diluted serum."[s] Having less fibrin, it has less azote and more carbon. Hence it is retained in a liquid form in the uterus for years, in cases of imperforate hymen; and stains of linen from it are more readily washed out than those from blood; and hence it putrefies far more slowly than blood if the air is excluded, and may be kept liquid and undecomposed in a bottle for years[t]; though, if the air be admitted, it absorbs azote, loses carbon, and therefore putrefies rapidly.

To regard women during menstruation as unclean is certainly very useful, though the custom among the American women of leaving their husbands' tents at this period for separate hovels is said by Hearne to give a pretence for quitting the good men whenever they are sulky, — even twice or thrice in a month.[u] Moses set a woman apart for seven days, and enacted that any one who touched her, or even any thing she had sit upon, should wash his clothes and be unclean till evening; and, if he lay with her, should be unclean for seven days.[x] But menstruating women have been regarded as mysteriously deleterious. The American Indians forbid them to walk near where there is fishing or hunting, or to cross the path where deer, &c. have been carried, lest success should be averted. In Pliny[y], a menstruating woman is declared the most pernicious thing in the world,—blighting fruit, destroying grafts and hives of bees, drying up fields of corn, causing iron and copper to rust and smell, driving dogs mad, and disgusting even ants with their food, &c. &c. In this country, it is firmly believed by many that meat will not take salt if the process is conducted by a menstruating woman.

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[q] *Recherches Expérimentales*, p. 251. sqq.

[r] *Outlines of Human Physiology*, 1837, p. 392.

[s] *Phil. Trans.* 1812.

[t] *Lancet*, vol. xiv. p. 250.

[u] *Journey from Prince of Wales Fort to Hudson's Bay, &c.* 1795. p. 313. sq.

[x] *Leviticus*, xv.

Gall says that, when he practised at Vienna, "he soon noticed that during a certain time few women menstruated, and at another a great many menstruated at once. As this frequently occurred, it excited his attention, and made him fancy that perhaps menstruation followed some law. He therefore kept a journal, in which he marked the periods of a considerable number of women for many years. It resulted that women are divided into two great classes, each class having a different period. The women of the same class all menstruate within eight days; after this time, an interval of ten or twelve days follows, in which very few women menstruate. At the end of these eight days begins the period of the second great class, all the individuals of which also menstruate within eight days. Suppose a woman of this class begins to menstruate on the first of the month, she will have finished on the eighth, if her catamenia continue eight days. Another, whose catamenia last but three days, will finish on the third; or, in case she did not begin till the fifth, she equally will finish on the eighth, and so the rest; all who are regular having an interval of twenty-one, twenty-five, or twenty-six days. The following are the two periods of women, each belonging to a different class, such as they really occurred. In 1818: January 19, 3; February 16, 1, 29; March 14, 28; April 10, 25; May 8, 23; June 5, 30, 19; July 26, 17; August 21, 13; September 18, 9; October 16, 8; November 14, 5; December 12, 2. It appears that each woman menstruated thirteen times in the year; and that she, who began on the 3d of January, menstruates for the fourteenth time on the last of December.

"There are always women who, through some accidental cause, have menstruated out of these two great periods; but, after one or two months they usually return to the class to which they belong. Women out of health, young persons who have not yet fully completed their growth, and women who are near the final cessation of the catamenia, are the most subject to these irregularities.

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[y] *Hist. Natur.* vii. 13.

" During my travels I continued my journal; and, what struck me the most was, that the two periods coincided in all countries, at least in Europe. At the same time that women menstruated in Vienna, Berlin, Hamburgh, and Amsterdam, they menstruated also at Bern, Copenhagen, Paris," &c.[z]

Some women have always peculiar symptoms before, during, or immediately after, menstruation; as violent headachs or some abdominal disturbance; and morbid affections in many women are aggravated at the period, or just before, or after.

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[z] *Sur les Fonctions du Cerveau*, t. iv. p. 355. sqq.

CHAP. XXXII.

CONCEPTION AND PREGNANCY.

"We now come to the functions for which the genital organs are given us, — to conception and the propagation of the species, in treating of which we shall first merely describe the phenomena that are observed in that admirable and truly divine process, and afterwards investigate the powers by which they are produced.[a]

"In the first place, it is worthy of remark that the human race, unlike most animals, does not copulate at certain periods of the year[b], but that with it every season is favourable to the flame of love.

"When a woman receives a man[c], and both burn with that animal instinct which is superior to all others in universality and violence, the uterus, swelling I imagine with a kind of inflammatory orgasm[d]," "draws in, as it were, the semen ejaculated by the male[e], and appears to pour forth a fluid of its own against it;

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[a] "On all the subjects of this section, consult, among many others, Fr. B. Osiander, *Observationes de homine, quomodo fiat et formetur*, in the *Comment. Soc. Reg. Scientiarum recent.* vol. iii. p. 25. vol. iv. p. 109."

[b] "Unless the observation first made by Wargentin, in Sweden, — that there is a greater proportion of births in September, which corresponds to the preceding December, be considered as relative to this point. *Swensk. Vetensk. Acad. Hadlingar.* 1767. vol. xxviii. p. 249. sq."

[c] "Of the various circumstances of this admission, I have spoken in my work *De gen. hum. variet. nat.* p. 17. sq. 3d edit."

[d] "*V.* the two instances of uteri seen by Ruysch, immediately after impregnation.

The one of a common woman, murdered by her paramour immediately after connection. *Adversar. Anat. Med. Chirurg.* Dec. i. tab. ii. fig. 3. The other of a married woman, impregnated a few hours previously, and killed in the act of adultery by her husband. *Thesaur. Anat.* vi. p. 23. sq. tab. v. fig. 1."

[e] "If we consider the impetus with which the semen is emitted, and, as it were, swallowed by the uterus, and how small a quantity is proved, by experi-

the tubes become rigid, and their fimbriæ embrace the ovaria, in one of which a ripe Graafian vesicle bursts like an abscess, and its albuminous drop of fluid, being absorbed by the abdominal opening of the tube, is conveyed to the womb."

Mr. Cruikshank, on inspecting the genitals of a female rabbit during heat, observed appearances nearly similar to those described by Harvey, Graaf, Ruysch, Diembroeck, &c.[f] He found them all prodigiously turgid with blood. The vagina was absolutely of a dark mulberry colour, and on the ovaria were prominent spots which injection proved to be vascular and which were swollen Graafian vesicles; the contents of the vesicles, however, remained transparent: the Fallopian tubes were also nearly black, writhing in an extraordinary manner, having a strong peristaltic motion, and embracing the ovaria with their fimbriated extremity so closely as to lacerate on an attempt to disengage them.[g] These observations were all confirmed by Mr. Saumarez.[h] During copulation, this state of the organs must be carried to the highest pitch of intensity: and the same condition of course takes place in the human female. That the semen is intended to enter the uterus is highly probable, even from the circumstance that the male and female orifices together form a cross,— that of the male urethra being vertical, and that of the uterus horizontal, — an arrangement that gives every chance for the semen to enter. Had they both been circular, horizontal, or vertical, the chances against their being exactly opposite would have been very great. Their different form makes their opposition certain, however much the glans or os uteri may incline from the centre during emission.

Harvey could never detect semen in the uterus after copulation.[i] Nor De Graaf in the vagina.[k] Verheyen found a large quantity in the uterus of a cow six hours after copulation.[l]

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ments on brutes, to be sufficient for impregnation, we shall be able to explain those well established cases of conception, where the hymen was imperforate, — cases commonly brought forwards in support of the existence of a *seminal aura*."

[f] Boerhaave, *Prælectiones Academicæ,* with Haller's notes, t. vi. p. 113. sq.

[g] *Phil. Trans.* 1797.

[h] *A new System of Physiology, &c.* vol. i. p. 337.

[i] Harvey, *De Generatione,* p. 228, &c.

[k] Regn. De Graaf, t. i. p. 310.

[l] Verheyen, *Sup. Anat.* tract. 5. cap. 3.

Galen always discovered it in the uterus of brutes after copulation.[m] Leeuwenhoeck, in the case of rabbits. Ruysch found it not only in the uterus, but in the Fallopian tubes of two women killed soon after connection.[n] Postellus, Riolan, Carpus, and Cheselden also believed they found it in the uterus.[o] Haller once found it in the uterus of a sheep, forty-five minutes after coition.[p] Fallopius frequently found it in the tubes.[q] Haller very justly remarks that some of those, who believed they saw semen in the uterus, probably saw mucus only. He inclines, however, with almost all physiologists, to the opinion that the semen does enter the uterus. The length of the penis, the force of emission, the peristaltic action of the vagina during the heat of some brutes[r], the existence of a bifid glans with two orifices in the penis of the males of some species the females of which have two ora uteri[s], the remarkable fact of the ora uteri being horizontal while the opening of the male urethra is vertical, which must give every chance to the entrance of the semen into the uterus, are circumstances of no little weight in favour of the opinion that the semen does penetrate at least into the uterus. John Hunter, however, actually saw it projected into the uterus of a bitch which he killed by dividing the spinal chord while she was united with the male.[t]

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[m] Galen, *De semine*, lib. i. c. 2.

[n] *Thes. Anat.* and *Adversaria Anat. Medic. Chirurg.*

[o] Boerhaave, *Prælect. Acad.* Haller's note to p. 182. t. vi.

[p] Haller, *Elementa Physiol.* t. viii. p. 22.

[q] *Opera,* i. fol. m. 421.

[r] See, for instance, Dr. James Blundell, in the *Med. Chir. Trans.* vol. x. p. 266.

[s] Account of the Structure of the Wombat, by Sir E. Home. *Phil. Trans.* 1798.

[t] Sir E. Home, *Phil. Trans.* 1817. Mr. Saumarez, l. c. p. 429.

Mr. Saumarez observed in two instances, when two hours and a half only had elapsed after coition, and before corpora lutea were formed, globular, pearl-coloured bodies, as large as a pin's head, which, on being squeezed, burst, and discharged a very subtle fluid to some distance. Dr. Haighton commonly met with them.

The well known instances of conception, where the admission of the male organ into the vagina was prevented by the great strength of the hymen, are sometimes cited against the opinion that the semen passes beyond the vagina, but certainly with no weight. 1. Because the most minute portion of semen is sufficient to impregnate: — Spallanzani mixed three grains of frog's semen with a pound and a half of water, and with a little of this mixture fecundated nearly all the nu-

Dr. Haighton, with the view of ascertaining whether it is necessary to impregnation that the semen pass along the Fallopian tubes, made a number of experiments on the effects of tying and dividing them in rabbits at different periods relative to coition.[u] The peristaltic action of the tubes, and their adhesion to the ovaria during the venereal ardour, argue strongly in favour of the semen being conveyed along them, because we can hardly suppose these circumstances to begin to occur at this period for the purpose of conveying the contents of the Graafian vesicle, as this does not burst till a considerable time after copulation. Dr. Haighton, indeed, says that these changes in the tubes did not take place in his experiments (all made, however, after copulation) till long (forty-eight hours) after copulation, — till the ovaria were about to discharge into them their vesicular fluids. In this he agrees with Bartholin, De Graaf, Schurig, Deswig, and Lang, who maintained, like him, that the semen, at least as far as examination went, does not enter the tubes.[x] But Mr. Cruikshank and Mr. Saumarez, two of the latest experimenters, assert the contrary in the detail of their experiments, and, as Haller remarks of the old partisans, the negative experiments of the former cannot overturn the positive testimony of the latter, — "Eorum experimenta *negativa* non possunt affirmantium fidem evertere:" Sbaragli, Verheyen, Hartman, and Duverney could find no *change* in the state of the tubes at any time, although their negative observations are completely overthrown by the positive observations of

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merous posterity contained in the threads taken from the female; and, after mixing three grains with even twenty-two pounds of water, he fecundated some. (*Dissertations*, vol. ii. p. 191. English transl.) 2. Because the vagina has an action of its own sufficient to move the semen onwards to the uterus: — it is seen during the œstrum of brutes (and also the uterus in a lower degree) to have a peristaltic movement; it often firmly embraces the human placenta; and Dr. Hamilton, the present obstetric professor of Edinburgh, mentions, in his lectures, having attended a physometric patient whose vagina sucked up air from without, as appeared from the emission of air ceasing in the warm bath, and Dr. Monro (secundus), likewise, was perfectly satisfied that the woman drew in the air. Any canal supplying the place of vagina, however small, probably executes the same absorbing action, or conveys the influence of the absorbing action of the womb.

[u] *Experimental Enquiry, &c.* by John Haighton, M.D. *Philos. Trans.* 1797.

[x] Haller, *Elem. Physiol.* and notes to Boerhaave, l. c.

all others who have inquired experimentally into the subject. Besides, the great abundance of blood in the genital organs, during the sexual ardour, must cause the tubes to enlarge and apply themselves to the ovaria: this, as Haller mentions upon the authority of Hartsoeker, occurs even in the dead body by means of injection.

Dr. Haighton, however, to prevent the semen from passing along the tubes, divided one of them in virgin rabbits, and, after the wound was healed, admitted the animal to the male. The ovarium on this side contained yellow bodies, which appear after vesicles have burst, equally with the other, proving that the Graafian vesicles had burst, although the semen could not possibly have reached the ovarium.[y] No fœtus, notwithstanding, was discoverable in any instance: on the other side (for in the rabbit the uterus is double) fœtuses were found equal in number to the yellow bodies or corpora lutea. Dr. Haighton concludes that impregnation may take place without the advance of semen along the tubes. His conclusion is perfectly just, according to his test of impregnation, — the escape of the contents of a Graafian vesicle. But I apprehend this to be no more deserving the title of a test of impregnation than the emission of the semen masculinum. Impregnation is that change wrought by means of the male semen in the contents of a Graafian vesicle, which enables them to become a developed fœtus. Now this was never effected when the tube was divided: — although the presence of corpora lutea proved vesicles to have burst, yet a fœtus was in no one instance discovered: in other words, the contents of the Graafian vesicles were in no one instance impregnated. Hence I conclude, with the old physiologists before the time of Harvey, that the conveyance of semen beyond the vagina, — where it may come in contact with the contents of an ovarian vesicle, is absolutely requisite to impregnation; and perhaps the state of the tubes during the heat of some brutes, and the occasional growth of fœtuses in the tubes, abdomen, and in the ovaria themselves[z], render it likely that the semen passes even into the tubes. But Dr. Haighton's experiments were unnecessary for this conclusion, because pathological observation proves sterility to be an invariable consequence of complete obstruction in any point between the os externum and ovaria,—in the Fallopian tubes, in the uterus, or in the vagina.[a]

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[y] The divided end of the tube was found totally impervious. The experiment succeeded when one tube only was divided: the division of both deprived the animal not only of fertility but of sexual desire, and caused the ovaries to shrink, and even the division of one had this effect in some instances. If the tube was divided after coition, the result was the same, provided the operation was performed before the contents of the vesicles had entered it; for, if too much time had elapsed, the ova were transmitted to the uterus and grew to maturity.

It is said that the division of the vas deferens sometimes has the effect of causing the testis to atrophy, and of both vasa deferentia to destroy sexual desire; so that this simple operation may be a substitute for castration. See *Lancet*, vol. xiv. No. 247. In an experiment by Sir A. Cooper, atrophy did not result. l. c.

When the obstruction in such cases is so far within as to allow the deposition of the semen, the sterility disproves the notion of Bartholin and Stenonis,—that this fluid operates by absorption.

Dr. Haighton imagines that the bursting of the vesicle is the sympathetic effect of the semen in the vagina or uterus.[b] Now

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[z] The fœtus has frequently remained in the ovarium. See, for instance, the *Phil. Trans.* 1680–3, and 1797 and 1820; also Schurig's *Embryologia*, p. 824. sq. where Bohn, Grundius, Ortlob, Blasius, and Littre, are quoted.

Such cases do not militate against the probability of the approximation of the semen masculinum to the ovarian contents being necessary for impregnation, because the tenuity of the vesicles, when ready for this operation, is such as we may suppose presents no barrier to the influence of the male upon the female fluid, especially if we reflect that oxygen and blood affect each other through a piece of moistened bladder. Indeed it is possible, even, that the vesicle bursts and the two fluids come into actual contact, but that imperfect rupture or some other cause detains the ovarian fluid till it has acquired permanent adhesions.

[a] Schurig, *Gynæcologia*, pars ii, p. 172. Morgagni, Ruysch, &c. &c.

Dr. Blundell repeated his uncle's experiments, with this variation, that he produced the obstruction not in the tubes, but in the uterus or vagina. Impregnation was of course equally prevented, and the ovarian vesicles burst as usual. *Med. Chir. Trans.* vol. x.

[b] "That the semen first stimulates the vagina, os uteri, cavity of the uterus, or all of them.

"*By sympathy*, the ovarian vesicles enlarge, project, and burst.

"*By sympathy*, the tubes incline to the ovaria, and having embraced them convey the rudiments of the fœtus into the uterus.

"*By sympathy*, the uterus makes the necessary preparations for perfecting the formation and growth of the fœtus, and,

"*By sympathy*, the breasts furnish milk for its support after birth."

There is reason, however, from one passage, to suppose that Dr. Haighton believed the semen to pass no farther than the vagina. After dwelling upon the opinion opposite to his own, he says, "The difficulties which were opposed to the conveyance of the semen by the tubes, were, as we should expect, intended to although on the side where the tube was divided the ovarium did discharge the contents of some vesicles, it is not proved to have done this through the operation of the semen. The venereal ardour alone was shown in the observations of Mr. Saumarez as well as in those of Mr. Cruikshank (and the same has been remarked in the human female[c]) to produce, among the other great changes of the sexual organs, the enlargement of the vesicles. Nay, we are certain that it will occasion the rupture of the vesicle without any commerce with the male. The hens of poultry lay eggs (incapable indeed of being hatched), although separated from the cock,—a circumstance proving that in them the œstrum is sufficient to enlarge and burst a vesicle, apply the tube to the ovarium, and occasion it to convey away an ovum. Aristotle and Harvey relate that many birds lay eggs from mere titillation; the latter proved it experimentally in the thrush, in the sparrow, and in a favourite parrot belonging to his wife. Blumenbach is satisfied with the accuracy of the accounts which he has read of corpora lutea in virgins; and since he wrote[d] we have been furnished with abundant instances of their appearance in virgins not only of our

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prepare the way for a different explanation; therefore physiologists, by a very natural transition of thought, were led to suppose that the presence of semen in the *vagina alone* was sufficient to account for impregnation:" and he immediately proceeds to relate his experiments. In fact I know this to be his opinion, because, in a MS. of his lectures that I rendered full and accurate by taking my notes in Latin, I find it said of Haller for believing that the semen always enters the uterus, "Now it is surprising that a man like Haller should do so, who, from his works, would seem to form his opinions, in general, on sound reasoning:" and Ruysch's cases are quite ridiculed, because this anatomist, "being now of an age when most other people can see but little, set about looking for something wonderful, and discovered what nobody had ever seen before, viz. semen in the uterus and Fallopian tubes."

[c] In the body of a young woman, eighteen years of age, who had been brought up in a convent and had every appearance of being a virgin, Valisneri found five or six vesicles protruding in one ovarium, and the corresponding Fallopian tube redder and longer than usual, as he had frequently observed in brutes during heat. Bonnet gives the history of a young lady who died furiously in love with a man of low rank, and whose ovaria were turgid with vesicles of great size. Blancaard, Schurig, Brendelius, Santorini, and Drelincourt, mention analogous facts. Haller's notes to Boerhaave's *Prælect. Acad.*

[d] *Spec. Physiol. &c.* anno 1788, quoted *infrà*, p. 781.

own kind, but among quadrupeds. Sir Everard Home[e] asserts that the corpus luteum is not a formation that fills up the cavity of a ruptured vesicle, but a substance in which the ovum is produced, and consequently no proof of conception. However this may be, the case remains the same; for he has repeatedly seen ovaria of both human and quadruped virgins that had discharged ova. Indeed he revives the old opinion of Kerckring[f], — that ova grow to maturity in succession and are discharged without copulation. I think it pretty evident that, although the semen has no share in bursting the ovarium, the high excitement of copulation contributes very considerably to it, since the inferior degree of excitement which occurs during the heat of brutes and in the lascivious states of the human virgin is sufficient frequently to effect the discharge of ova. It is perhaps impossible otherwise to explain the fact that ova are so commonly expelled from the ovaria and impregnated whenever a connection is arbitrarily or casually brought about. Hen pigeons, if kept with males, lay not only at an earlier age, but all the year round, instead of merely in the spring.

The vesicles burst in different animals, and perhaps in the same, at various periods from two hours to seven or eight days after coition. In the rabbit, Mr. Cruikshank found them burst in two hours; Dr. Haighton saw them bursting at the end of forty-eight hours; De Graaf on the third day; M. Coste most frequently found them burst on the second or third day: in the dog, Haller once found them burst on the following day, and always before the sixth; MM. Prevost and Dumas not before the sixth or seventh. Kuhlemann saw them burst in the sheep at the end of the first day.

" After the escape of this drop from the ovarium, the lips of the wound are closed by an external cicatrix, and the vascular membrane which contained the drop is converted into a *corpus luteum*.[g] This is at first hollow and full, as appears to me, of plastic lymph[h], which in progress of time becomes a fleshy nucleus[i], surrounded by a thick, remarkably vascular, cortex.[k]" These characters of the external cicatrix, the internal cavity, the firmness and vascular nature of their substance, rendering them capable of injection, distinguish them, it is said, from spurious corpora lutea that are independent of impregnation.[l]

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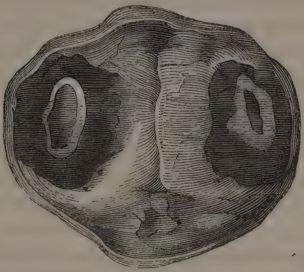
[e] *Phil. Trans.* 1819.

[f] *Anthrop. Ichnogr.* 1. 3. and 12. quoted by Schurig. " Tam conjugatæ quam virgines hæc ova sæpissime excernunt, insensibiliter quidem, quia non advertunt, nec quicquam de iis suspicantur."

[g] " See J. Chph. Kuhlemann, *Observat. circa negot. generat. in ovib. factæ.* Gotting. 1753. 4to. c. *f. ae.*"

[h] " See Everard Home's contrary opinion respecting the origin of the corpus luteum and its relation to the ovum, *Phil. Trans.* 1817, p. 255. and 1819, p. 59."

After two years a little substance no larger than a grain of millet, or even merely a dark spot, remains.



Ovarium of a woman who died in the fifth month of pregnancy.

The corpus luteum, in common with the whole ovarium, is divided and laid open, and is seen to be hollow.—(W. Hunter.)

" After the impregnation of the womb, the canal which runs along the cervix of the uterus is thoroughly closed, especially towards its superior or internal orifice," with jelly-looking secretion, "so that superfœtation, properly so called [m], cannot naturally take

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[i] " See W. Hunter, *Anatomy of the Gravid Uterus*, tab. xv. fig. 5. tab. xxix. fig. 3. tab. xxxi. fig. 3."

[k] " It is a celebrated question, of great importance both in physiology and forensic medicine, and much agitated of late years, whether a corpus luteum is the consequence of a fruitful coition only, and therefore an infallible sign of conception, or whether it may occur independently of coition, and therefore exist in virgins. We trust that we have established the truth of this point, and shown the conditions under which a corpus luteum may occasionally be formed even in virgins. *Specimen physiologiæ comparatæ inter animantia calidi sanguinis vivipara et ovipara*, in the *Commentat. Soc. Reg. Scientiar. Gotting.* vol. ix. p. 109. sqq."

[l] Dr. Montgomery, *Cyclop. of Pract. Med.* article PREGNANCY.

[m] " That different conceptions may occur from the repetition of copulation after very short intervals is proved by the instances of adulterous women who have brought forth twins resembling different fathers in the colour of their skin: *viz.* of black women who have brought forth a black and a mulatto, and of European women who have brought forth a white and a mulatto."

An instance of superfœtation of this description occurred to the late Mr. Blackaller of Weybridge. A white woman of very loose character left her husband, and sometime afterwards returned pregnant to her parish, and was delivered in the workhouse of twins, " one of which," says Mr. Blackaller, in an place. There are scarcely any constant and infallible signs by which the woman herself can be very certain of the changes that occur within during conception.[n]"

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account which he sent me, "was born of a darker colour than I have usually observed the infants of negroes in the West Indies; the hair quite black, with the woolly appearance usual to them, with nose flat and lips thick:" the second child had all the common appearances of white children. Another is recorded by Dr. Dewees.* The mother was a servant in Montgomery County, and, on the report that she was pregnant, a black and a white man both ran away from the estate. Her mistress was present at the birth of the *black and the white twins*, and they were afterwards often seen by Dr. Dewees. One occurred at Rouen in 1806, in which there was a *white and mulatto* child, and the woman, the *chère amie* of a white, confessed, on close examination, that she had twice yielded to the embraces of a negro when she supposed herself four or five months advanced in pregnancy. (*Annales de Montpellier*, quoted in the *Journal de Médecine*, t. xii.) The case of a married negress, who one morning admitted a white to her arms as soon as her black husband had risen, and produced a *black* and a *mulatto*, is recorded by Dr. Moseley as having occurred within his own time at Jamaica. (*Tropical Diseases*, p. 111.) One was recorded in 1821, by M. de Bouillon; a negress brought forth a *negro and a mulatto* child, and confessed having received the embraces of a white and a negro the same evening. (*Bulletin de la Faculté de Médecine*, 1821.) The most recent occurred in the Lying-in Hospital of Berlin, January 25th, 1832, where a woman brought forth female twins, the one white, the other half caste. She confessed an intercourse with a negro shortly after conceiving by her husband. (*Dublin Journal*, from Hecker's *Berlin Weekly Medical Newspaper*, Jan. 1834.)

We may, therefore, agree with Pliny (*Hist. Nat.* vii. 9.), who asserts that "Ubi paululum temporis inter duos conceptus intercessit, utrumque perficitur:" and believe his account of a girl in Proconnesus who produced twins, one resembling her master, the other the bailiff, having favoured both on the same day; no less than the other case of the same kind to which he alludes, and that there was some foundation for the story of Hercules and Iphicles.

The uterus has been sometimes wanting (Lieutaud, Sandifort, Morgagni, Stein, Theden, Schmucker, Engel, Girdwood, in the London *Med. Gazette*, 1837,

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[n] "Ad. El. Siebold, *De diagnosi conceptionis et graviditatis sæpe dubia.* Wirceb. 1798. 4to.

Gm. Theoph. Kelch, *De symptomatibus et signis graviditatis earumque causis.* Regiom. 1794. 4to."

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* Cox's *Philadelphia Medical Museum*, vol. i. The case usually quoted occurred in America (South Carolina), and may be found in Buffon.

The pulse becomes quicker, and the blood buffy. The catamenia generally cease, though sometimes they continue, but seldom after the cervix is distended; and in a few women they continue during the whole of pregnancy, in whom they are pro-

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the subject the woman murdered by Greenacre), sometimes destitute of anterior opening (Plouquet), and sometimes double (*Ephemerid. Natur. Curios.* Dec. 3. Ann. 7. and 8. Obs. 35. Cent. 9. Obs. 75. *Phil. Trans.* vol. iv. 1699, &c. &c. *Med. Facts and Observations*, vol. iii. translated from the German, *Med. Chir. Trans.* vol. xvii.), in which last case superfœtation has been imagined possible at any period after the first conception, provided each uterus have a distinct orifice, and the unimpregnated happen not to have a decidua crassa, as it sometimes has, or, though it have, happen not to have its cervix obstructed by this, as it was in a case dissected by Dr. R. Lee. (*Med. Chir. Trans.* vol. xvii.) It has been removed after inversion and when diseased, and lives have been saved by this operation. (*v. c.* Newnham, *Inversio Uteri.* Davis, *ibid.* T. Windsor, *Med. Chir. Trans.* vol. x. &c. &c.)

A dissection is described by Dr. Granville (*Phil. Trans.* 1818), of a woman who had borne eleven children, male and female, and who died soon after being delivered of twins of both sexes. The right half only of the uterus was found developed, the left extending scarcely half an inch from the centre and shaped to a perfectly straight line: the left tube and ovary did not exist. This proves, if the proof were required, that one ovary is, like one testis, sufficient, not only for procreation, but for the procreation of offspring of both sexes. The writer thinks the case useful in proving also both that twins and twins of different sexes may come from the same ovary, contrary to the opinion of all physiologists, he says, except Sir Everard Home. The not very uncommon fact, however, of three or more children being produced at a birth has always proved the former circumstance, and the opinion not held by Sir Everard Home was relinquished a century ago. The doctrine of each ovarium furnishing a different sex, is indeed found in Hippocrates, Aristotle, Galen, Lactantius — a superstitious father of the church, Rhases, and Avicenna; but has been so long exploded, that Dr. Parsons, in his *Enquiry into the Nature of Hermaphrodites*, p. 43., written a century ago, declares it "cannot but seem obsolete before even a capacity of the lowest class." A sow from which John Hunter extracted an ovarium farrowed eight times afterwards and produced seventy-six pigs. This was known to Sir E. Home.

As each fœtus, where there are more than one, may possess a separate placenta and chorion, and may come into the world solitarily, at the distance of some months perhaps from the other delivery, we see how easily practitioners may fancy a superfœtation, when there is simply an expulsion of twins, triplets, &c. at different periods. Still, I think, there can be no doubt of many cases of the simultaneous birth of children apparently of different periods, as well as of the bably furnished by the vagina. Some always menstruate up to a certain time of their pregnancy, and some have menstruated during pregnancy only. Frequently nausea and even vomiting occur, and chiefly in the morning: they may begin at conception, or at any subsequent time; this, however, is usually about the twelfth or sixteenth week; they may cease at any time, but generally, if they begin early, they cease at from the twelfth to the sixteenth week: they may continue till delivery. Cardialgia, and longings for particular articles of food, sometimes singular or even disgusting, are often noticed. The circumstance of longing during pregnancy is rather curious. Many pregnant women long for certain nice articles of food, and become much distressed if not gratified; but others for coals, sealing-wax, flax, tar, chalk, raw meat, and live fish. Tulpius mentions a lady who devoured 1400 herrings in her pregnancy. But Ludovicus Vives tells us of a woman who longed for a bite in the back of a young man's neck, and would have miscarried if not gratified; and Langius, of another who had set her heart upon biting a baker's shoulder, which she saw bare and white as he carried his bread to the oven every morning. The husband bribed the baker at so much each bite. The poor fellow stood two very manfully, but, when a third was talked of, his courage failed. A woman at Andernach on the Rhine longed for her husband, and is declared to have murdered him, eaten what she could, and salted the rest for another day.[o] One pregnant woman longed for a priest's heel and bit at it, "nihil illius clamorem expavescens, quo deorum hominumque fidem et subsidium ille implorabat." Another ate 20 lb. of pepper in her pregnancy: another, a live carp from head to tail: another bit off the heads of twelve mullets and ate them: another brought bread, dipped it in the grease-tub of a ropemaker, and devoured it greedily.[p] One lady informed me that in all her pregnancies she acquired a disgust of tea, and after the first month or two an intense longing for salads. These longings and aversions are no doubt affections

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birth of children apparently of the same period at intervals of a few months. See examples by Dr. Maton, *Trans. of Col. of Physicians*, vol. v.; Foderé, *Méd. Légale*, t. i.; and by Dr. Dewees, *Philad. Med. Mus.* vol. i.

[o] Shenkius, l. c. *de Gravidis.*

[p] *Ephem. Nat. Cur.* an. 2.

of the brain, and approaches to monomania of the organ of the instinct of feeding; and we not only often notice them, but a greater or less change of the mental character. The sweetest temper may become peevish, and a degree of disturbance amounting to absolute monomania may occur. Gall saw "four instances of women who in their ordinary state had not the least inclination to steal, but who in their pregnancies were violently impelled to it."[q] The face may grow pale, and even sallow; the eyes be encircled by darkness, or grow hollow; the whole system become thin and feverish, so that the person a little resembles one labouring under an organic disease; the legs may swell. The areola of the nipple turns dark, and this is most remarkable in women who have not often been pregnant, because frequent pregnancy produces in it a permanent dark hue. If the female was growing, growth may be suspended. Ulcers may not heal, and teeth may become carious. Neuralgic toothache is very common in pregnancy: and other neuralgiæ are sometimes experienced. Some pregnant women always have a cough: I knew one always hoarse; and various singular sympathies take place in different women. The blood of pregnant women has usually a buffy coat. Dr. Thackrah, as well as others before him, found the quantity of fibrin to be increased, as well as that of the red particles and albumen.[r] The secretions are often altered in their sensible qualities. If the breasts are secreting, the milk may become disgusting to the child: if not refused, it may disorder the child's system. Discoloration, and even more intense diseases of the skin, may take place. On the other hand, a pregnant female may improve in her health, and may grow fat. Existing diseases may be mitigated, suspended, or cured. Even phthisis pulmonalis is often suspended, though to become more quickly fatal after delivery or after weaning, for suckling acts in some respects like pregnancy, though less powerfully.

Immediately after impregnation the uterus begins to grow more soft, vascular, and turgid. Its inner surface soon pours forth a quantity of soft matter, which at length becomes organised into false membrane precisely as happens in the case of inflamed serous membranes; so that in about a fortnight the "internal surface becomes lined with plastic, and, as it were, inflammatory, lymph (fibrin), which forms the tunica *caduca* or *decidua* of Hunter.[s] This is said to consist of two laminæ, — the *crassa*[t] investing the uterus," except its cervix, "and the *caduca reflexa*[u], so denominated from being, after the ovum begins" "to take root in the decidua, continued" closely "over the other parts of the ovum, just as the" close or visceral portion of the "peritonæum is continued over the abdominal viscera." The reflexa is the finer and formed later, being never found unless when an ovum is discoverable in the uterus. The fibrin of the crassa blocks up the uterine extremities of the Fallopian tubes as well as the cervix, according to Boehmer, Samuel, Lobstein, Moreau, Velpeau, Burdach, though this is not always the case with the very extremities of the Fallopian tubes, and a bristle may thus sometimes be passed a short way through the orifice.[x] The ovum, entering the uterus, plunges into the decidua crassa, and pushes this before it as it expands by growth, and thus obtains this close additional coat—the reflexa.[y] An opening, or rather concavity, therefore, exists for a time in the decidua where the ovum entered its substance[z]: but this is soon closed up by the abundance of its fibrin. If the Fallopian tube through which the ovum passes is blocked up, the ovum has only to expand behind the decidua crassa, and thus produce the reflexa; if the tube is not blocked up, the ovum passes into the cavity of the decidua crassa first, and then buries itself in the soft substance of this membrane at some part or other of the uterus, and as it expands still raises a portion before it in the cavity of the decidua crassa, and this portion thus becomes the decidua reflexa.[a] At the part of the ovum which remains attached and does not push the decidua before it, there is no decidua reflexa, and this portion of the decidua crassa becomes the maternal half of the placenta, presently to be described. The ovum thus lies between decidua crassa and reflexa on the one hand, and decidua crassa and ultimately maternal placenta on the other;—universally encased in crassa, and to a great extent also in reflexa. (See *infrà*, p. 799.)

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[q] *Fonctions du Cerveau*, t. i. p. 450. Temporary insanity is not uncommon after delivery.

[r] *An Enquiry into the Nature and Property of the Blood.* London, 1834. p. 147. sqq.

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[s] "Aretæus Cappadox (*De Causis et Sig. Morb. Diuturn.* l. ii. c. ii. p. 64. sq., Boerhaave's edition) seems the first who gave a true account of the origin of this membrane, the more accurate knowledge of which we owe to Wm. Hunter. After the revival of anatomy, Fallopius restored the knowledge of it. *Observ. Anat.* p. 207.

It is the *chorion*, either simply called so, or the *spongy*, *tomentous*, *fungous*, *filamentous*, *reticulated*, of the following age; the *involucrum membranaceum* of B. S. Albinus.

The first delineation of it was given, as far as my knowledge extends, by Ruysch. *Thes. Anat.* v tab. i. fig. 1. F.B.C.G."

[t] "This is called *cribriform* by the distinguished Fr. B. Osiander."

[u] "By Osiander, the membrane, *ovi crassa*. See B. S. Albinus, *Annotat. Acad.* l. i. tab. iii. fig. i. e. W. Hunter, l. c. tab. xxxiii. fig. 1—4."

[x] See Dr. R. Lee's cases, *Med. Chirg. Trans.* vol. xvii. 1832.

[y] W. Hunter, Burdach, Burns, Bojanus, Boch, Carus, Moreau, Velpeau, Wagner.

[z] Burdach, *Die Physiologie als Erfahrungswissenshaft.* Leipzig, 1826, sqq. §344.

Above a century and a half ago, De Graaf maintained from careful observation that the germ exists in the ovarium.[b] The fact was violently opposed, and generally rejected. But, in 1827, Baer announced the discovery that a mature, though unfecundated, ovarian vesicle of a bitch contains a membrane loosely applied against it and composed of granules united by a solid and transparent substance[c]: that the fluid within is viscid, yellow, and pellucid: that the granulations are particularly accumulated at one spot, forming a disc, perforated at its centre, and thus annular (*discus proligerus*): that in the centre of the disc, at some distance from it, but surrounded by a clear fluid which seems to attach the ovum to its inner edge, lies the ovum, spheroid, seldom above $\frac{1}{200}$ of an inch in diameter, and consisting of an external membrane fine and transparent, and an internal thick and opaque and inclosing a little cavity. The subject was further investigated by Coste, Bernhardt, and Valentin. The last observed[d] in mammalia that within the external membrane of the ovum was a layer of yellowish granulations united by a limpid viscid fluid and apparently similar to the yelk itself of an egg; and at the surface of this, immediately under the external membrane, was the *vesicula proligera*, or germinal vesicle, a simple membrane containing a viscid limpid fluid, and discovered already in the cicatricula of birds by Purkinje in 1825: so that the germ did not lie within the substance which is analogous to the yelk, as appeared when the fluid within the outer membrane was supposed to be such, but lay outside the yelk as in the eggs of birds. The most external membrane, — that of the ovarian vesicle, bursts when the vesicle is mature, and the true ovum, or germ, and its membranes pass along the Fallopian tube.

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[a] Burdach, § 344. Boch has described and represented an ovum in the act of pushing the decidua crassa before it. *Diss. de Membrana decidua Hunteri.* Bonn. 1831. 4to.

[b] *De mulierum organis generationi inservientibus*, cap. xii. Lugd. Batav. 1672.

[c] *Epistola de Ovi Mammalium et Hominis Genesi.* Lipsiæ, 1821.

[d] *Handbuch der Entwickelungsgeschichte der Menschen*, p. 20.

Dr. Martin Barry has recently published a most elaborate microscopic paper on the subject[e], and finds more or less error in these accounts. He contends that the external vesicle of the ovum, or ovisac, as he terms it, is originally elliptic, and becomes more spherical afterwards; first perfectly transparent, and at last translucent only: and that it is at first exceedingly small, so that a cubic inch would contain upwards of 200,000,000 in the ox, and he has seen them in the dog measure only $\frac{1}{100}$ of a Paris line, or $\frac{1}{1125}$ of an English inch. That it is often at an early stage found without organic union in a cavity of the proper substance of the ovum, or of the walls of a Graafian vesicle; and in the latter case,—that of an ovisac being parasitic, it may be either within a covering subsequently obtained by the ovisac to which it is parasitic, or in this covering itself. That, when the ovisac is originally produced, it forms itself around both a number of peculiar granules, more or less elliptic, generally flattened, measuring from $\frac{1}{100}$ to $\frac{1}{400}$ of a Paris line, or from $\frac{1}{1125}$ to $\frac{1}{4500}$ of an English inch, transparent, having each at least one nucleus, and being often punctate apparently from minute oil globules, and soluble in water, and, as well as the granules, a pellucid and partially coagulable fluid. That in the midst of these is concealed the most primitive element of the ovum, — the germinal vesicle and its contents. That, after the production of the germinal vesicle and its contents, the peculiar granules and oil-like globules accumulate, and conceal it, thus giving it an envelope; but that the liquefaction of some globules, or the addition of some other fluid, at length renders it visible in the centre of the ovisac. The formation of the oil-like globules with a pellucid fluid indicates the incipient production of yelk: and at a certain stage of its production two membranes form around it,—the internal, or proper membrana vitelli, and the external, or true chorion. The germinal vesicle is at first in or near the centre of the yelk; but subsequently passes to its surface. In the rabbit, after coition, the membrana vitelli, previously so thin, becomes very thick; and the chorion, imbibing fluid into its interior, becomes distended, so that a minute space exists between the two membranes. The thickening and distension afterwards increase considerably, as appears by the state of the ova in the Fallopian tube. In birds, mammalia, amphibia, and fish, there are germinal vesicle and contents, yelk, and membrana vitelli; but in mammals only is a true chorion given in the ovary. In the other three classes the substance expelled from the ovary is only a yelk ball; in mammals, a true ovum. When the ovum is mature, the peculiar granules form themselves into three parts: 1. A covering of granules, — *tunica granulosa*, investing the chorion; 2. A lining to the interior of the ovisac, — *membrana granulosa;* 3. Between these a central mass of granules with chords which extend from the membrana granulosa and suspend the ovum, — *retinacula*. The *ovisac* itself is formed around the peculiar granules, at a very early stage, — before these have given rise to the three parts just mentioned. It is supported in the centre by the equable diffusion of the granules in the fluid; a coat of dense cellular tissue is produced outside the ovisac soon after the ovum is completely formed; and the union of the two is a *Graafian vesicle*.[f] From the centre of the yelk, and therefore of the whole Graafian vesicle, the ovum passes gradually to the periphery, and,

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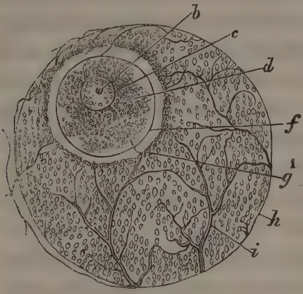
[e] *Phil. Trans.* 1838.



Ovum of the mole. 440 *diameters.*

b Germinal spot (yellowish).
c Germinal vesicle.
d Yelk.
f Chorion.
g Tunica granulosa in the course of formation.
h Ovisac.
i Blood vessels.

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[f] What is termed the calyx in birds, amphibia, and fishes, hanging from the ovary, and invested partly by its substance and sometimes by peritonæum, is thought by Dr. M. Barry to be ovisac and this external coat.

what is interesting, always to that portion of the periphery which is directed towards the surface of the ovary; the retinacula disappear on one side and grow shorter on the other, to effect this change of place, and they now retain the ovum in its new situation, and probably contribute by pressure to the attenuation of the Graafian vesicle at the point of the exit of the ovum. Granules escape when the Graafian vesicle bursts, and these are chiefly tunica granulosa and ruptured retinacula. The tunica granulosa accompanies the ovum into the Fallopian tube.

Dr. Wagner has discovered a spot on the inside of the germinal vesicle, — the germinative spot.[g]

Dr. M. Barry observes that, in mammalia, myriads of ovisacs with their contents are formed which never reach maturity, whether parasitic or not, and that a continual disappearance and fresh formation of ova go on at a very early age. The order of formation in the ovum of mammalia is, therefore,

1. Germinal vesicle and contents.
2. Envelope of oil-like globules and peculiar granules.
3. Ovisac around this envelope.
4. Yelk within the ovisac and around the germinal vesicle.
5. Proper membrane of the yelk, while the yelk is incipient.
6. Chorion.
7. Proper covering of the ovisac; the peculiar granules arranging themselves about the same time to form the

Tunica granulosa,
Retinacula,
Membrana granulosa.

Those of these structures which exist in other vertebrata appear in the same order of time.

The period at which the ovum arrives in the uterus probably varies. In 1817, Mr. Bauer found the ovum in it on the eighth day, as he thought[h]; M. Velpeau believed that he examined one aborted on the fourteenth after having been apparently in the uterus for two or three. But Burdach considers every account of the detection of the ovum in the human uterus before the end of a fortnight unworthy of credit. The rabbit goes 28 days; the dog 63; the sheep 135; and the ovum is not detected in the uterus of the rabbit before the end of the fourth day; of the dog, before the eighth, and even then some ova are in the oviduct; and of the sheep before the nineteenth: — in none of these earlier than the expiration of a seventh of the whole duration of pregnancy. A fortnight is one twentieth of the duration of human gestation. If they arrived in the uterus at the end of a seventh, they would not arrive before the fortieth day.

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[g] *Lehrbuch der Vergleichenden Anatomie*, s. 351. Leipzig, 1834—5.

[h] *Phil. Trans.* 1817.

"The ovum consists[i] of two proper velamenta or membranes, besides an external covering."

The exterior membrane is "the *chorion*[k] of the moderns, the external surface of which is, from the first, nearly covered with inexpressibly beautiful knotty flocculi; whence it has been called the *flocculent*, *leafy*, or *mossy*, *chorion.* By means of these flocculi which are the rudiments of the fœtal portion of the future *placenta*, the ovum takes root, as it were, in the uterine decidua," and becomes firmly fixed to the uterus at a variable period in the second or third month. They are described by M. Velpeau[l] as not vessels, but merely granulated filaments which serve afterwards for the developement of the vessels of the placenta. They are very evident at the end of three or four weeks; appear to be only spongioles or suckers to nourish the fœtus, till, at least half being implanted in the decidua and ceasing to be further developed, the rest become the rudiments of the placenta, in which vessels are developed. At the full period the chorion, covered by the decidua and placenta, is reflected over the root of the chord, which it covers as far as the abdomen of the fœtus. The chorion may be separated into two layers, and Meckel has found fluid between them; the external is termed by Burdach, Exochorion. Its inner surface is connected by fibrils or delicate vessels with the outer surface of the interior layer, which is termed Endochorion. It gives the sheath to the vessels of the chord, and is regarded by Burdach as the original covering of the ovarium and analogous to the vitellary membrane which encloses the yelk and reniform membrane of the proligera in birds. The endochorion or inner layer is entirely vascular and cellular membrane, and this second and internal layer is not found before the end of the second month, when the veins and arteries of the embryo, extending beyond its navel, and expanding with cellular membrane, produce it.

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[i] "Respecting the membranes of the ovum, and their connection with the uterus and embryo, vide J. F. Lobstein, *über die Ernährung des Fœtus.* Halle, 1804. 8vo."

[k] "The *membrana media* of Rouhault, Haller, &c., the *vasculosa* of Osiander. For the various synonyms and homonyms of the membranes of the ovum, consult Haller, *Elem. Physiol.* vol. viii. P. i. p. 194. sq. and Tabarrani's letter to Bartaloni, *Atti di Siena*, t. vi. p. 224. sq."

[l] *Embryologie, ou Ovologie Humaine, &c.* Alf. L. M. Velpeau, &c. Paris, 1833.

The interior membrane is "styled *amnion*[m]," "delicate, but remarkably tough." In the first month its relations are with the chord only, which seems to perforate it in order to arrive at the front of the spine and lose itself in some of the abdominal viscera; and, when the abdominal parietes are formed, it becomes continuous with the epidermis of the fœtus. Though its vessels contain no blood, it is undoubtedly vascular, and, when diseased, vessels are evident in it.

"These two proper membranes of the ovum differ very much from each other in size" at the end of the first month. "The chorion appears a large bladder, to the interior of which the amnion, like a much smaller bladder, adheres in that part only which nearly corresponds with the centre of the external flocculent surface of the chorion." The amnion is not detected before the sixteenth day. About the eighteenth it appears as a vesicle at the back of the embryo and continuous with its ends and edges, the embryo resting upon it. At length the embryo is found within it, from the circumstance of the walls of the trunk, originally open, now closing in front, so that the attachment of the amnion becomes limited to the navel.

"The remaining space between the chorion and amnion is filled by a clear water, which may be called the *liquor chorii*, of doubtful origin and short duration." It is reddish, transparent, of the consistence of albumen, and, though abundant while the embryo is in the chorion only, decreases on the amnion becoming enclosed in the chorion.

"For, since the amnion increases more rapidly than the chorion, and approximates to the latter even during the first months after conception[n], in proportion to its approximation must this fluid necessarily be absorbed. Occasionally the liquor chorii is excessive, and maintains them separate till birth, giving a sort of dropsy or "false waters."

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[m] "The *membrana tenuis* of Osiander; in French, *la coiffe*."

[n] "See Hunter's figures (imaginary indeed), l. c. tab. xxxiv. fig. 9. 8. 7."

"The internal membrane of the ovum is filled, from its first formation to the last moment of pregnancy, with the *liquor amnii*[o], an aqueous fluid, of a yellowish colour, nearly inodorous, of a bland and scarcely saltish taste, and compared to albumen, from which, however, more accurate investigation proves it to differ considerably."[p] It consists of about 1·2 of albumen, osmazome, sugar of milk, ptyaline, soda, and hydrochlorate of soda, lime, and phosphate of lime, with 98·8 of water.

"Its source" "cannot be referred to the fœtus or umbilical chord, because it exists in abortive ova containing neither." Burdach contends that it is imbibed from the fluids of the mother by the chorion and then by the amnion: for, not only, when Dr. Mayer injected coloured fluid into the trachea of a pregnant rabbit, was it found in the liquor amnii[q], as saffron and mercury are when taken by pregnant women, but Dr. Otto found the skin of a fœtus of five months of a reddish brown and as hard as parchment, wherever it was in contact with the liquor amnii, in a woman poisoned by sulphuric acid, although no other organ than the skin was affected.[r]

"Its quantity is inversely as the size of the fœtus.

"Hence we may conjecture that its use," at least after the early periods, "is rather to defend the fœtus while nearly gelatinous, and most liable to suffer from external injuries, than to afford nourishment, which latter opinion is, indeed, refuted by the numerous instances of full-grown and well-fleshed fœtuses *destitute of a head.*[s]"

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[o] "Paul Scheel, at the end of his *Commentat. de liquoris amnii asperæ arteriæ fœtuum humanorum natura et usu.* Hafn. 1799. 8vo.

C. H. D'Zondi, *Supplementa ad anat. et physiol. potissimum comparatam.* Lips. 1806. 4to."

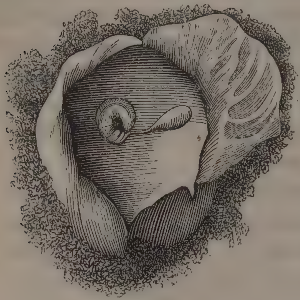
[p] "Steph. J. Van Geuns, *De natura et utilitate liquoris amnii.* Ultraj. 1793. 4to."

[q] *Med. Chir. Zeitung.* 1817. t. ii. p. 431.

[r] Burdach, § 462.

[s] "Consult the distinguished Tiedemann, *Anatomie der Kopflosen Missgeburten.* Landshut, 1813. fol. p. 52. D. Welge, a medical practitioner at Goslar, and formerly a favourite pupil of my own, has enriched my museum with an excellent example of this kind, *viz.* a twin female fœtus without head, arms, blood-

"The EMBRYO[t], which swims in this fluid, suspended by the umbilical chord, like fruit by its stalk, begins to be formed about the third week after conception[u]: at first it appears of rather a globular shape, resembling a little bean or kidney, from which the rudiments of the extremities grow, and on which the face is at length formed, &c.[x]"



An abortion of about six weeks.

Outside is the chorion, all flocculent. Inside the amnion, firm and more translucent than the arachnoid. Within the amnion is the embryo, attached to it by a short, unseen, chord. The vesicula umbilicalis spoken of at p. 796. sq. is also represented, attached to the centre of the body by a fine thread. — (Sömmerring.)

Dr. Pockels, however, declares he has seen the embryo on the fourteenth day, one twelfth of an inch in length.

"By nature woman is *uniparous*, conceiving but one fœtus. Frequently, however, she produces twins, the proportion of which

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vessels, or thorax, born (what is particularly worthy of notice) *alive*, after a perfect and vigorous sister, for it repeatedly extended and bent its legs before it perished on being seized with a general horripilation."

[t] "C. Fr. Burdach, *De primis momentis formationis fœtus.* Regiom. 1814. 4to."

[u] "There is no occasion in our times to refute the false remarks and figures, published by Mauriceau, Kerckring, and others, of fœtuses one or a few days old.

The reasons of my fixing upon this time, I have explained at large in the *Medicin. Bibliothek.* vol. ii. p. 673. sq.

How remarkably this was afterwards confirmed by fact, will be found in the same work, vol. iii. p. 727."

[x] "Those, who have not an opportunity of inspecting the fragile primordia of our race, may consult the excellent plates in Ruysch's *Thesaur. Anat.* vi. tab. ii. fig. 2, 3, 4, 5. 8. 10. *Thesaur.* x. tab. iii. fig. 1.

Also B. S. Albinus, *Annotat. Acad.* l. i. tab. v. fig. 4, 5.

Trew, *Commerc. Litter. Noric.* 1739. tab. iii. fig. 4, 5.

Abr. Vater, *Mus. anatom. propr.* tab. viii. fig. 2. 4, &c.

And, instar omnium, Sömmerring's *Icones Embryonum Humanor.* Francof. ad Mœn. 1799. fol."

to single births Süssmilch estimates as 1 to 70.[z] In these cases, each child has usually its own amnion, whereas there is a common chorion.[a]"

During fifty-seven years, above 78,000 women were delivered at the Dublin Lying-in Hospital, and the proportion of women producing twins or more was about 1 in 57[b]: and during a subsequent period of seven years, of 16,617 births, 480 children were twins; and of these, 245 were males.[c]

According to the registers of the Lying-in Hospital of Paris, during twenty years, 37,441 deliveries occurred; in 36,922 of which was only one child; in 444, two; and in 5, three. No greater number occurred, nor even for forty years before, in the whole of which sixty years were 108,000 deliveries. Of 54 twin deliveries, taken at random from the list, 15 were of a boy and girl; 13 were of girls; and 26 were of boys, — nearly half of the whole number.[d]

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[z] "The proportion is not very constant, and is liable to national variety.

Egede expressly mentions the infrequency of twins among the Greenlanders, *Descr. du Groenland,* p. 112.

Their remarkable frequency, on the contrary, among the people of Chili is asserted by Molina, *Saggio su la Storia Naturale del Chili,* p. 333."

[a] "See Denman, *Engravings tending to illustrate generation and parturition.* Lond. 1787. fol. tab. ix.

Twins are very rarely contained in a common amnion. Vide J. de Puyt, *Verhandel. der Zeeuwsch Genootsch. te Ulissingen,* t. ix. p. 423. sq.

Consult Hor. Garneri, *Mém. de l'Acad. de Turin,* 1809. Append. p. 89."

[b] John Cross, *Sketches of the Medical Schools of Paris,* p. 192.

[c] Dr. Collins, *Dublin Journ. of Med. and Chem. Science,* Nov. 1831.

[d] *Edinb. Journal of Med. Science,* Jan. 1827, p. 366. sq.

From a census of England and Wales, it appears that between 1810 and 1821 — a period of ten years — 1,664,557 males were born, and 1,590,510 females. (*Population Abstract,* p. 154.) In the fifty-seven years, at the Dublin Lying-in Hospital, the male births were to the female as 10 to 9. (Mr. Cross, l. c.) Of 16,617 born there, in 7 years from 1826, there were 8,548 males, and 8,069 females; 4,987 were first children, and of these the males were 2,622. (Dr. Collins, l. c.) According to Dr. Hufeland (*Edinb. Phil. Journal,* vol. iii. p. 296. sq.), the number of males in Germany was as 21 to 20, born from 1811 to 1820 inclusively: the number of males exceeded that of females every year, and in the whole was 1,664,557, while that of the females was 1,590,510. He states that the numbers over the whole earth are as 21 to 20, and that this proportion occurs daily in a population of 10,000,000, weekly in one of 100,000, monthly in one of 50,000, yearly in one of 10,000; in small societies, every 10 or 15 years. Burdach suggests that the excess of male births may be

Four children are sometimes produced, and even five; but this is the highest number known, except in the case of the wax matron, who, for a judgment, once lay in of as many as there are days in the year. Some women produce more than one child at a birth repeatedly, and Gottlob mentions one who blessed her husband with eleven children at three births. The greater the excess of children born together, the greater their mortality.

There is a common notion, that, if twins are of different sexes, the female cannot breed. This I know is erroneous.[e]

" The medium of connection between the mother and child are the umbilical chord and the placenta in which this is distributed.

" The *umbilical chord*, which appears coeval with the embryo," though Dr. Pockels dates its appearance from the third week, and is covered by an inner coat from the chorion, and an outer from the amnion, " varies exceedingly in length and thickness, in the place of its insertion into the placenta, in its varicose knots, &c." M. Velpeau observes that swellings exist along it in the earlier months, separated by contractions, and generally disappearing before the fourth month. " It always consists of three blood-vessels twisted spirally together, viz. a vein running to the liver of the fœtus, and two arteries arising from its internal iliacs or hypogastrics. They are separated from each other by cellular septa of

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explained by the circumstance of males being generally older than the women whom they marry, according to the effects of disparity of age mentioned above at p. 709. More boys than girls die before fourteen years of age, and thus perfect equality is produced at puberty. The surplus of males has been thought greater among legitimate than among illegitimate children. The proportion of still-born males to still-born females has been thought greater than the proportion among those born alive. But Dr. Collins (l. c.) found that, of the 16,617 births, 498 were premature (*infrà*, p. 822.); of these the still-born were 293; and of these again the males were 255. A larger proportion of illegitimate than of legitimate children are still-born.

Among different species of plants and brutes there is much variety in this respect, in some the sexes being equal, in some the male predominating. But Burdach, considering the female to be the primitive sex, that whose sexual organs by elongation become the male, that which exists when there is but one sex, that which is absolutely necessary, for which the male is formed, and for a large amount of which a small proportion of male infusion is sufficient, sees it no wonder that in general females predominate greatly in plants and brutes.

[e] See abundant instances of such females breeding, in the *London Med. Repository*, 1823.

various directions[f], and are throughout narrowed internally by nodules, or the *quasi-valves* of Hoboken.[g]" They have not been found by M. Velpeau before the first half of the second month of gestation. They are not twisted spirally on each other, according to him, before the swellings have disappeared. The twisting is always in the same direction, "such," in the words of Dr. W. Hunter, "as would be produced by turning the child round upon its navel as a centre, by pushing its head towards the right side and its feet to the left."

"They are collected into a chord by means of a cellular membrane, which is full of a peculiar, very limpid, fluid, called Whartonian, resembling gelatine in appearance, and is surrounded externally by a continuation of the amnion.

"At the part of the chord which is united to the fœtus, there enters the *urachus*[h] between the two umbilical arteries, and it arises from the fundus of the urinary bladder. In the human subject it is pervious but for a" time,—only the first three or four months, "and, indeed, soon disappears altogether." "It leads to the allantoid.[i]" The "*vesicula umbilicalis*, found in human ova between the chorion and amnion[k], is not analogous to the allantoid[l], but to the *tunica erythroides* which is seen in the ova of some mammalia, and to the vitellary sac of the incubated egg. It is found in healthy human ova, the second or third month after conception, too frequently and of too constant an appearance to be regarded as accidental, morbid, or monstrous[m];" but is generally thought to disappear about the third month. A late maker of good anatomical preparations, named Miller, declared that the intestines were an elongation of its duct.[n] It appears to be analogous to the yelk bag of birds, and to supply nourishment during the earliest months. Though physiologists believe that it disappears about the third month, Mr. Miller said he possessed a series of human preparations of the placenta, exhibiting it onwards to even the ninth month. Hunter and Meckel had previously seen it occasionally at this late period. It, however, is not larger when existing at this late period than at the third month.

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[f] "W. Noortwyk, *Uteri Humani Gravidi Anatome*, tab. iii. fig. 5, 6, 7."

[g] "Hoboken, *Anatome Secundin. Human. repetita*, p. 522. sq. fig. 38, 39, 40. This structure is further displayed in the arterial branches of the placenta by Aug. Chr. Reuss, *Nov. Observ. circa Structur. Vasor. in Placenta Humana.* Tubing. 1784. 4to."

M. Velpeau mentions a fœtus at Brussels, whose umbilical chord was inserted into its head. He has seen an instance of but one umbilical artery; and he refers to another.

[h] "J. Noreen, *De Uracho.* Gotting. 1749. 4to.

Ph. Ad. Boehmer on the same, at the end of his *Anatome ovi hum. fœcund. sed deformis.* Hal. 1763. 4to."

[i] "Vide Fabr. ab Aquapendente, *De Formato Fœtu*, tab. xii. xiii. xiv. xvii. fig. 27. xxv."

[k] "Vide *Commentat. Soc. Reg. Sc. Gottingens.* vol. ix. p. 128. fig. 1."

[l] "Among the moderns who still compare it to this, are J. F. Lobstein, l. c. *über die Ernährung des Fœtus.*

And C. H. D'Zondi, *Supplem. ad Anat. et Physiol.*"

The *allantoid* is very small, appears about the fourth week, and nearly disappears at the sixth; in brute mammalia it becomes very large.

Dr. Pockels has discovered another vesicle in the human subject, which he calls erythroid, and regards as the source of the umbilical chord.

The chord consists at first of the umbilical vein and two umbilical arteries, the urachus, some of the intestinal canal (more as the embryo is younger), the vesicula umbilicalis, and an artery and vein, called omphalo-mesenteric, belonging to the vesicle, that accompany the chord together till they reach the abdomen, when the vein joins a mesenteric vein and the artery joins the superior mesenteric artery.

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[m] "The opinions both respecting the natural constancy of the vesicula umbilicalis and its analogy to the *tunica erythroides*, I originally, as far as I know, proposed fifty-three years since, in the first edition of my *Institutiones* (1787), and in my *Specimen Physiologiæ Comparatæ* (1788) formerly quoted.

The connection of this vesicle with the intestinal canal of the embryo, and indeed with the appendix vermiformis of the cæcum, is shown by Laur. Oken in his and Diet. G. Kieser's *Beytr. zur Vergl. Zoologie, &c.* fasc. i. ii. Bamberg. 1806. sq.

See likewise Kieser's *Ursprung des Darmkanals aus der vesicula umbilicalis, dargestellt im menschlichen Embryo.* Goett. 1810. 4to.

But, on the contrary, Fr. Meckel shows it to be united with the diverticulum of the small intestines (Diverticulum Littrianum), *Beytr. zur Vergl. Anatomie.* vol. i. fasc. i. Lips. 1808. p. 93.; and more fully in Reil and Autenrieth's *Archiv. für die Physiologie,* vol. ix. p. 421.

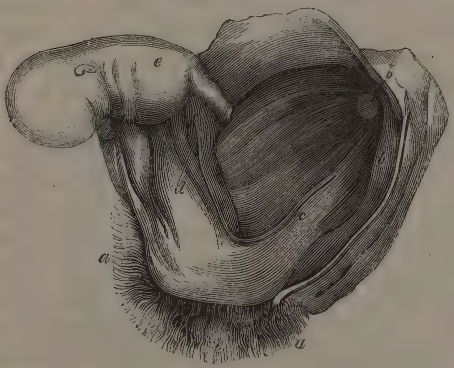
Consult, among many others, W. Hunter, *Anatomical Description of the Human Gravid Uterus* (a posthumous work edited by Matthew Baillie). Lond. 1794. 4to. p. 40. sq.

B. N. G. Schreger's *Letter* to Sömmerring, *De functione placentæ uterinæ.* Erlang. 1799. 8vo."

[n] *Lancet*, April 7. 1838.

"The blood-vessels of the chord pass to the *placenta*, of whose origin from the leafy surface of the chorion that is united to the DECIDUA CRASSA we formerly spoke. Hence we discover how the substance of the placenta" has a two-fold origin, "being formed from the decidua and uterine vessels on the one hand, and from the umbilical vessels distributed upon the chorion on the other."

An abortion of ten weeks.



a a, The only portion of the chorion now flocculent, the smooth part having grown disproportionately.

b, Vesicula umbilicalis, covered by the amnion, and lying in the narrow extremity of the ovum.

c, Filament running from the vesicle to the embryo, across the umbilical chord.

d, A hernial sac, consisting of a dilatation of the chord, and containing intestine.

e, The embryo withdrawn from the membranes.

The decidua reflexa covers the whole ovum except where it is attached to the crassa and by means of this to the uterus. Here the crassa, not being expanded by the expanding ovum into reflexa, becomes the maternal portion of the placenta. Thus the reflexa of the ovum ends at the edge of the placenta; and, before the portion of the crassa to which the ovum adheres has become the maternal placenta, the reflexa necessarily ends at the same part of the crassa. (See *suprà*, p. 787.)

"The increase of the ovum is irregular, the smooth part of the chorion growing more rapidly than the mossy; consequently, the size of the placenta bears a greater proportion to that of the ovum, the shorter the time that has elapsed since conception, and a smaller, as the period of labour approaches.

"As pregnancy advances, its texture becomes gradually more compact; furrowed and lobular on its external surface, which lies towards the uterus, and smooth on the inner surface, which is covered by the amnion, and lies next the fœtus." At full time it covers about a quarter of the chorion, is six or eight inches in diameter, twelve or fifteen lines thick at its centre, and thinner at the sides, and about a pound in weight. "It varies greatly in size, thickness, figure, and situation or place of attachment to the uterus; generally it adheres to the fundus; it is equally destitute of sensibility and true irritability." No nerves are discoverable in it. Schott [o] has demonstrated that from five to seven nervous filaments pass from the left hepatic plexus in the region of the liver to the umbilical vein, which one of them accompanies to the umbilicus, and that each umbilical artery receives from the hypogastric plexus a filament which runs an inch and a half beyond the inguinal ring. It is not only formed at first in distinct lobes, but the vessels of contiguous lobes do not communicate: each lobe independent, each has a distinct branch of the umbilical vessels, and each is formed from one flocculus of the exochorion. The fœtal placenta is composed of ramifications of the umbilical vessels, flocculi of the exochorion converted into sheaths for them, soft spongy cellular membrane resembling coagulated fibrin, and, according to Dr. Granville, of a cortical membrane said by Baer to invest the ovum originally, and which Dr. Granville maintains is what Dr. W. Hunter mistook for his decidua reflexa.[p] Though the cortical membrane is destined for absorption during the first months of pregnancy, Dr. Granville declares that a portion still remains at the spot where the placenta forms, and to serve the purpose of dividing into groups the filiform vessels of the chorion that become part of the placenta, and of covering these groups or cotyledons. These cotyledons are ramifications of the umbilical arteries and veins, — subdivisions of these vessels running horizontally on the fœtal surface of the placenta,—the terminations of the chord. Between them are spaces in which the surface of the chorion is smooth and shining, and clear of all vessels. The amnion accompanies the chorion to form an exquisitely fine pellicle for the ramifications of the cotyledons. The two arteries separate a little before arriving at the placenta, and then usually communicate by a transverse branch before they ramify. Both they and the veins ramify in a radiated manner on the inner surface of the placenta, and their branches are of the finest description. Each artery penetrates a flocculus, ramifies in its ramifications, and turns back to become a vein, undistinguishable in texture from the arteries. The ramifications of each flocculus, artery, and vein, form a lobule or cotyledon.[q]

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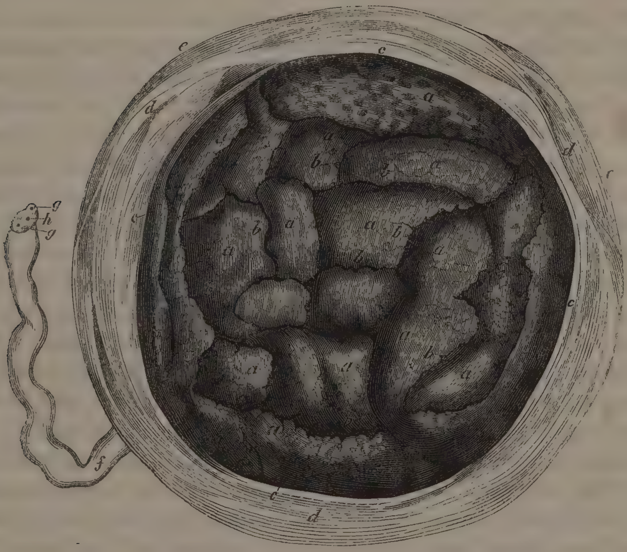
[o] Burdach, § 448.

[p] Dr. Granville, *Graphic Illustrations of Abortion.* London, 1833. p. iv. sq.



a a a a a a, Lobes of the external surface of the placenta.
b b b b b b, Grooves between them.
c c c, Circular sinuses around the circumference of the placenta.
d d d, External surface of the chorion.
e e, External surface of the amnion.
f, Umbilical chord.
g g, Section of it: the umbilical arteries.
h, Umbilical vein.

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[q] Burdach, § 448.

"Although all agree that the placenta is the chief instrument in the nourishment of the fœtus, the true mode of its operation, and its mutual relation to the uterus and fœtus, have given rise to great controversies in modern times." "No anastomosis exists between the blood-vessels of the uterus and of the chord." Injections passed into the umbilical arteries neither escape nor enter the maternal vessels, but return by the umbilical vein; nor do injections passed into the uterine vessels find their way to those of the chord. When the placenta is separated, blood issues from the artery, but none from the fœtal placenta; or, if the placenta is not separated, but the chord cut, the placental part soon ceases to bleed. Dr. Hunter discovered that congeries of arteries and veins proceed from the decidua, and penetrate between the minutest branches of the fœtal cotyledons, invested, Dr. Granville finds, by projections of decidua [r], but, however, only lie among, and are unconnected with, the fœtal vessels of the chorion. These maternal decidual vessels of the placenta are supplied with blood from the uterus; for, if a pregnant uterus is injected, the decidual or maternal vessels of the placenta become filled; and Dr. Hunter discovered (and his observation is established) natural apertures in the uterine surface of the placenta if it is removed, through which the decidual vessels may be injected as the chorial may through the umbilical arteries.[s] The formation of the decidua being analogous to that of an adventitious membrane on the pleura, vascular communications between the lining membrane of the uterus and it take place as between an adventitious membrane and the pleura—by new and adventitious shooting vessels. Dr. Hunter thought that the uterine vessels passed through the decidua into cells, upon which the fœtal vessels ramified. Many deny the existence of cells, and conceive that the uterine vessels simply ramify among the fœtal in the placenta. But the veins of the maternal placenta dilate into vesicles at their roots. Very large openings, communicating with the veins of the uterus, and produced by laceration, are seen on the inner surface of the uterus when the placenta has been separated from it. Although the placenta itself is not formed in the earliest months, the vessels of the decidua and chorion exist and must lie among each other as they do afterwards in the placenta. Still,

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[r] Dr. Granville, l. c. p. xv.

[s] l. c. p. xv.

"up to the tenth week the decidual vessels are as yet slender, straight, and insulated; while the umbilical vessels begin already to arrange themselves in minute cotyledons."[t] There being no vascular communication between the maternal and fœtal portions of the placenta, the blood of the latter is supposed to imbibe nutritious fluid from the mother through the sides of the vessels.

As there is no intermixture of blood, we are not surprised to find that Hewson discovered the red particles of the blood of the fœtal chicken and viper different (or larger) from those of the adult animals; or that MM. Prevost and Dumas observed them to be as large again in the fœtal goat as in the adult.[u] The blood of the fœtus is darker than than that of the mother, less thick and coagulable, without phosphates, contains but a small proportion of fibrin, has a soft crassamentum, and grows but slightly scarlet in the air. Imbibition, however, is proved by the detection, in the fœtal blood, of prussiate of potass given to the mother[x]; by the odour of camphor in the fœtal blood a quarter of an hour after camphor had been injected into the veins of a pregnant bitch[y]; by the tinge of the serum, urine, liquor amnii, teeth and bones of fœtal pigs, after four ounces of madder had been eaten daily by the pregnant mother[z]; by the tinge and odour of rhubarb, and its precipitation by carbonate of magnesia, in the amniotic fluid, the first urine, and in the serum of the blood of the umbilical chord, of six infants to whose six mothers ten or fifteen grains of rhubarb had been given by Dr. Granville every night for about a week up to the period of delivery.[a] The delicacy of the veins allowed Croupier and Béclard to pass mercury from the umbilical vein to the maternal veins of the placenta, but the texture of the arteries forbad imbibition. The water of coloured injections has passed from the fœtal to the maternal vessels when their texture had been impaired a whole day by death, though the experiment did not succeed immediately after death. Dr. Hunter conjectured that the fœtus was nourished by thousands of small lymphatic vessels which absorb nourishment from the mothers and carry it along the navel-string.[b] Wrisberg[c], Everhard, Pascoli, Needham, Röslin[d], Uttini[e], declared they saw absorbents in the chord; in fact the funis has been called a tissue of absorbents, with the exception of the blood-vessels. Fohmann has delineated them extending in profusion from the placenta along the chord, some stopping at the navel, others running to the absorbents between the epidermis and cutis, and others towards the groin to join the iliac glands. Lobstein and Meckel have failed to discover them, and Burdach and Weber consider that Fohmann injected mercury into cellular membrane only. The absence of all direct communication between the ovum and mother in man and mammal brutes is perfectly in accordance with what occurs in oviparous brutes and in vegetables. The ovum is deposited in the uterus to be hatched, and its stay there after leaving the oviduct or Fallopian tube is its period of incubation; whereas birds' eggs and seeds are hatched actually out of the body. The egg is closed all around, and the embryo of the egg has no connection with the mother. During the greater part of its life the vegetable embryo has none, and absorbs the fluid only which is deposited from the internal membrane of the seed.

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[t] Dr. Granville, l. c. p. xviii.

[u] *Suprà*, p. 160.

[x] *Edinb. Med. and Surg. Journ.* I am uncertain of this reference.

[y] Magendie, *Précis Elém.* t. ii. p. 578.

[z] Dr. Mussey, *American Journal of Med. Science*, Nov. 1829.

[a] l. c. p. xx. sq.

Originally the vesicula proligera is supplied in the ovum with nutritious substance for the germ; and, as soon as the ovum has escaped, it is nourished like a vegetable, growing in the tube and uterus by imbibing the surrounding fluids at its surface. The vesicula umbilicalis and perhaps the allantoid and erythroid are thus supplied with nutritious substance. When the chord is produced, this conveys nourishment from the surface of the chorion to the embryo; and, as soon as the placenta is produced, conveys it from the placenta. We have seen that, before the placenta exists, the whole surface of the chorion is flocculent, though in the earliest periods the flocculi are not vascular. There must be a reason for this; and we cannot doubt that the flocculi imbibe the fluid secreted by the uterus into the decidua, which at early periods is full of fluid and is in fact a mere pulp. The earlier the period, the finer must they be, and the more easily will they imbibe. The liquor amnii is accordingly more abundant, proportionally, the earlier the period, and absolutely at the middle period than at the last, for it then amounts to two lbs., while at full time it amounts to but one lb., and Lobstein asserts that it contains less albumen towards the end of utero-gestation than earlier [f]; and, before the placenta is produced, it contributes importantly, in all probability, to nutrition by means of the soft surface of the embryo. The surface of the chorion absorbs a little to the latest period. Although the liquor amnii is very aqueous, a calf has been just as well nourished with it only as with milk for a fortnight [g], and, as the milk is also immediately after birth very aqueous, the liquor amnii may be sufficiently nutritious. Brugmans found the absorbents of the chorion full in embryos removed from the uterus of brutes, when those of the intestines were empty: and declares that, after putting ligatures upon the limbs and plunging them in liquor amnii, the lymphatics swelled with fluid below the ligatures and subsided on the removal of the ligature. We shall find that some parts are smaller at a subsequent part of fœtal life than at a previous, that some disappear, and others atrophy in spots so as to become perforated. These changes must supply matter for general nourishment. We shall find also that the fœtal stomach and intestines contain soft matters which must be more or less absorbed constantly and afford support.

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[b] MS. Lectures, seen by Dr. Granville.

[c] *Observ. circa Placentæ ac Funiculi Umbilicalis absorbentia Vasa.* Gotting. 1790.

[d] Quoted by Schrager, *De Functione Placentæ Uterinæ, ad virum illustrem S. T. Sömmerring, Epist.* Erlangæ, 1799.

[e] *Ueber die einsaugenden Gefässe des Mutterkuchens.* Meckel's *Archiv.* vol. ii.

All seeds and eggs require atmospheric air, and produce in it the same changes as the plant or animal in after life. In vegetables and the lowest animals, and even during the primordial period of the higher and of man, the chemical changes take place in the embryotrophe in mass without any special apparatus. Organs, however, soon form, but as much for nutrition as purification,—the cotyledon of vegetables and the umbilical vesicle of animals. The cotyledons absorb water and purify, and red blood is seen first in the umbilical vesicle. Its contents and vessels in the human embryo disappear about the third month, when the placenta forms. It is doubtful whether the cervical branchiæ effect chemical changes in mammalia as they do in the Batrachians, or are mere vestiges of inferior organisation,—formed in accordance with a general plan.

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[f] *Ueber die Ernaehrung des Fœtus*, p. 146.

[g] Weydlich, *Lehre der Geburtshülfe*, t. i. p. 213.

The fœtal blood becomes purified in the placenta by the maternal, as the adult blood is purified in the lungs by the air. The ramifications of the umbilical artery have no fibrous coat, are excessively thin, and so subdivided as to be little larger than a globule of blood in diameter, smaller than the vessels of the adult lungs. Berzelius says that Fourcroy is almost the only author who has examined the blood of the fœtus, and his observations[h] "seem to have been made by chance, and not to be deduced from any experiment;" "credible authors have asserted that the eye cannot distinguish between the arterial and venous blood of the fœtus."[i] Bichat could observe no difference in the arterial and venous blood of the umbilical chords of several guinea-pigs examined while the mother's respiration was still continuing after an opening had been made into the abdomen, "—les deux sangs offraient une noirceur égale."[k] So too in regard to dogs.[l] Meckel admits no difference.

Yet Dr. Jeffrey[m], Dr. Chapman[n], and Dr. Bostock[o] have seen the arterial and venous blood differing in colour, and the latter declares the difference to be so obvious that he "feels surprised" at the opinions of Bichat and Berzelius. Schutz, however, declares the colour of the blood of the umbilical vein to be intermediate between that of arterial and venous blood. Müller observed no difference of colour in the arterial and venous blood of the chord of cats, &c., but a great difference in the fluid of the fine ramifications.[p] The blood of the vein resembled arterial blood much more than that of the umbilical arteries, in as far as it coagulated less quickly, became soon covered with a thick membrane in the air, gave out oxygen by heat, and became darker in vacuo and when exposed to carbonic acid gas. Lavagna also observed the blood of the vein to give a coagulum more solid and abundant in fibrine than that of the umbilical arteries. We shall see that the blood from the placenta goes direct to the brain by the inferior cava, right auricle, and left ventricle ; and that of the superior cava to the right auricle and ventricle and descending aorta through the umbilical arteries to the placenta; so that the former course is like that in after life through the pulmonary veins and left ventricle, and the latter like that through the right ventricle and lung. The head is much larger proportionally than after birth; and that arrangement is evidently to supply it with purified blood. If, before respiration, the chord is compressed, the fœtus dies before death could occur from want of nourishment, and even sooner than from suffocation after birth ; and yet the blood could have proceeded without mechanical impediment through the ramifications of the descending aorta in the lower part of the body to the inferior cava, to pass as before to the head. If the child breathes, the chord may be compressed with impunity; when it breathes strongly, the blood ceases to flow in the chord ; if respiration is suspended, immediately the blood flows again in the umbilical arteries. The same changes were observed by Carus when he let young rabbits out of the membranes, and afterwards plunged them under warm water. The purification takes place between two fluids, as in the respiration of fishes ; not, however, by instinctive movements, but continuously and passively, as in tadpoles.

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[h] *Annales de Chimie*, t. vii. p. 162.

[i] *Animal Chemistry.* Translation, p. 41. sq.

[k] *Recherches Physiologiques*, p. 271.

[l] *Anatomie Générale*, t. ii. p. 344.

[m] *De Placenta.*

[n] Dr. Chapman, *Philadel. Journ. of the Medical and Physical Sciences*, No. 1. p. 10.

[o] *Elements of Physiology*, Ed. 3. p. 409.

[p] *De Respiratione Fœtus*, p. 163. sqq.

The changes in the blood can, however, be dispensed with by the fœtus much longer than by the adult. For respiration may be deferred a considerable time after birth, circulation continuing even although the placenta has been expelled ; especially if the temperature is maintained by a warm bath, according to Drs. Chapman and Rousseau. When respiration has commenced, its continuance is less dispensable, but for some time more so than subsequently.

As the chick, in the egg, cut off from all intercourse with the mother, requires its blood to be purified by the external air, the egg does not hatch if the shell is varnished ; and, if, during the latter half of incubation, the shell is carefully opened, the chorion, to use the language of Blumenbach, presents one of the most splendid spectacles in the organic creation ; the arteries are seen carrying blood of a bright scarlet, and the veins of a livid red.[q] As soon as an egg is laid, some of the water of the white evaporates, and a space is left at the larger end between the layers of the membrane of the shell, and this increases till it will hold half a cubic inch of air. During incubation, eggs are always placed obliquely, with the large end highest, and the rest of the egg may be varnished with impunity if this is left bare. The eggs of insects produce identical changes. Seeds produce the same changes as plants, and, as germination requires darkness, germinating seeds absorb carbon and exhale oxygen. It has been remarked that pure oxygen excites germinating seeds so much that the young plant is weak or perishes. Some vegetables cannot bear the air at first, and require to be covered with a glass; and Dr. Paris considers that the reason of a puncture in the large chamber of an egg destroying the chick is that it allows the entrance of too much air.[r] The fœtus of the kangaroo has no vascular connection with the mother, being surrounded by a kind of jelly, and is supplied with external air by tubes opening into the uterus from without for this express purpose. Some of those who believe in placental absorbents conceive that the fœtus may be nourished by the absorbents only, and its blood purified by the purer fluids of the mother. The umbilical vein is discovered some time before the umbilical arteries, and appears originally to convey a milky fluid which is found in the placenta, analogous to chyle, and thus, according to the late Dr. Young of Edinburgh, to act as a thoracic duct.

The temperature of the fœtus is directly dependent upon the mother, and not upon the chemical changes going on in itself or its placenta. Autenrieth and Schutz took two fœtuses from the uterus of a rabbit, and allowed one to remain connected with the placenta, but separated the other and killed it by dashing it violently on the ground. Both cooled at the same rate, and originally their temperature was 27°, while that of the mother was 30°. Still, as chemical changes are going on, and as a child born at full time can maintain a temperature above that of the air far better than one born at seven months, we must presume that the fœtus contributes somewhat to its own temperature.[s]

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[q] *Comparative Anatomy.* Translated by Mr. Lawrence, § 375.

[r] *Trans. of the Linnæan Society*, p. 309.

[s] Burdach, § 464.

In 1819, a surgeon at Geneva, named Major, discovered the sound of the fœtal heart through the parietes of the abdomen. For two years his announcement excited no attention: but in 1821, M. Kergaradec presented an able memoir to the Académie Royale of Paris on the subject. Some, incapable of observation, denied the fact: and, what they could not hear, they contended others had not heard.[t] But, like others, I have witnessed it repeatedly, and it is now established. Generally it is scarcely perceptible till about the twentieth week; and the rate of the pulsation is from about 130 to 150 double sounds to the end of pregnancy. They sometimes become very rapid while we are in the act of listening; and the extent over which they are heard is about four fingers' breadth. If the child moves, they are quickened. The extent is less accordingly as there is less liquor amnii; though the strength and clearness are even the greater. The spot at which they can be heard is generally about the middle of the uterus, and more to one side than the other, and this is usually the left. If there are twins, there is a second pulsation at some distance; but very indistinct before the membranes have ruptured and labour commences. Dr. Kennedy, in a case of twins, found the pulsations of one to be 130 and of the other 145.

But M. Kergaradec discovered a second sound, of corresponding character, synchronous with the mother's pulse, in different parts of the uterus, and chiefly near the funis. It was termed the placental sound. But, though usually loudest in the neighbourhood of the placenta, it is not always; is heard sometimes in opposite spots, and when the child is dead, and even when labour is over: so that it is ascribed to the impediment to the course of the blood through the great uterine vessels, occasioned by their contortions or pressure, and possibly the compression of the great pelvic vessels by the womb may contribute to it.[u]

" During the progress of pregnancy, while the fœtus and secundines are increasing, the uterus of course undergoes important changes[x], not only in size, but in situation, figure, and especially in its texture, which is considerably altered both with respect to its blood-vessels and the intervening parenchyma, from the constant and great congestion of fluids that occurs in it.

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[t] The subject is fully treated in *Observations on Obstetric Auscultation*, by Evory Kennedy, M.D. Dublin, 1832.

[u] Dr. Kennedy, l. c.

[x] " L. Ph. J. Pott, *Commentatio præmio regio ornata de corporis fœminæ gravidæ mutationibus, &c.* Gott. 1815. 4to.

" In proportion as the uterus increases, the blood-vessels from being tortuous and narrow become more straight[y] and capacious, and the veins, near the termination of pregnancy, acquire so great a bulk[z] as to have been taken for sinuses by some anatomists.

" The parenchyma becomes gradually more thin and lax[a], especially in the part nearest the ovum, so that, although the gravid uterus is very thick, particularly at its fundus, and in a living and healthy woman is turgid with blood and replete with vital energy, nevertheless it is soft, and its general nature (especially after death, when, as Arantius long since remarked, it almost appears lamellated if pregnancy was advanced[b]) extremely different from the firm and compact substance of the unimpregnated uterus.

" The remaining important changes[c] of the gravid uterus, as well as those still more remarkable ones which occur to the ovum and fœtus, we will briefly relate in the order of the ten lunar months, according to which pregnancy is at present very conveniently calculated.

" As the uterus immediately after impregnation always becomes turgid, so, increasing from that period in bulk and weight, it descends rather lower into the upper part of the vagina, still retaining its former figure during the first three months, except that its fundus becomes a little more convex, and its anterior portion somewhat recedes from the posterior, and that its cavity, before extremely small and nearly triangular, becoming expanded by the fluids of the ovum, accommodates itself to the subglobular form of the latter.

W. Wagner, on the same subject, *Commentatio quæ secundam palmam tulit.* Brunsv. 1816. 8vo."

[y] " *v.* W. Hunter, *Anat. Uteri Gravidi*, tab. xvi."

[z] " Ibid. tab. xviii."

[a] " *v.* B. S. Albinus, *Annotat. Acad.* i. ii. tab. iii. fig. 2."

[b] " Arantius, *De Humano Fœtu libellus*, p. 5. sq. 1579. Compare B. S. Albinus, *Tab. Uteri Gravidi*, ii."

[c] " Among others consult J. Burns, *Anatomy of the Gravid Uterus.* Glasgow, 1799. 8vo. — a work carefully and faithfully executed."

" The ovum itself, which about the termination of the first month is of the size of a pigeon's egg, and possesses both deciduæ separate from each other and the minute amnion separate from the larger chorion, commonly attains, near the end of the third month, the size of a goose's egg; the decidua reflexa then very closely approaches to the crassa, and the amnion to the chorion; the amnion is filled with a large quantity of fluid which bears its name and defends from the pressure of the womb the tender embryo that is now very small in proportion to it, scarcely indeed equal in size to a young mouse, and hanging headlong and rather unsteadily.[d]"

The decidua crassa arrives at its full growth soon after the first month, and then gradually becomes less perceptible; though some maintain that it continues till delivery. The reflexa in the third month is even thicker than the crassa, but soon afterwards wastes, and after the fourth month unites with it into a delicate layer of cellular membrane.

" From the fourth month, the uterus becomes more oval or subglobular, and, its neck gradually softening, shortening, and almost disappearing or rather extending laterally, it again tends upwards and begins to rise to the superior part of the pelvis. At the same time the tubes ascend with the convex fundus of the uterus, and are extended and elongated, but adhere to the sides of this organ so firmly, that half of their length only is separate from it, and, at first sight, they appear to arise from the middle of it, — a circumstance which gave occasion to an erroneous opinion of the enormous increase of its fundus.

" After this period, the fœtus acquires a size more proportional to the capacity of the ovum, and becoming, at the same time, conglobated together, acquires a more fixed situation, which it preserves to the end of pregnancy; the head is inclined to the chest and the back bent, and generally placed rather towards one side of the mother.

" In the middle of pregnancy, — at the end of the fifth month, so much has the uterus increased, that its fundus is nearly between the navel and pubes, and pregnancy becomes externally evident.

" From this period, the fœtus by its motion is generally more distinctly perceptible to the mother: this circumstance, however, occurs at no definite time.

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[d] " v. Doeveren, *Specimen. Observ. Academ.* p. 104. sq."

"The uterus and fœtus continuing to increase during the remaining five lunar months, the fundus of the former reaches the umbilicus about the sixth month; after the eighth, having risen higher, it approaches the scrobiculus cordis. In the mean time, the cervix is gradually obliterated, flattened, and attenuated." Towards the seventh month the fœtus becomes more or less covered with a yellowish substance, something like spermaceti, of a nature between mucus and fat, termed *vernix caseosa*, secreted by the cutaneous sebaceous follicles, and abundant chiefly about the head, axillæ, and groins.

"In the tenth month, the uterus, overwhelmed as it were with its own bulk, — being eleven inches in length and nine or more in breadth, begins again to sink.

"Each decidua, but especially the reflexa adhering to the chorion, having for many months been growing thinner, now almost appears a net-work of short white fibres.[e]

"The larger diameter of the placenta is now nine inches; its thickness one inch; its weight one pound or upwards.

"The length of the umbilical chord is generally eighteen inches or more, — which is considerable if compared with that of other mammalia.

"The weight of a common full grown fœtus is usually about seven pounds; its length about twenty inches.[f]"

A twin is seldom so large as a solitary fœtus. Some assert that twins generally weigh no more together at birth, others that twins and even triplets do not generally weigh together above four or five pounds more, than a single child. Sometimes one twin is far larger than the other: and occasionally one is altogether blighted after a time, so as to be mistaken for a more recent formation or the result of superfœtation. If seeds are sown too near together, their growth is impeded. Dr. John Clark found boys weigh in general nine ounces on birth more than girls[g]: and this is supposed to explain the greater proportion of still-born boys than girls, while the smaller size of twins explains why the proportion of still-born twin boys is less than of boys born singly.

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[e] "On the various appearances of the decidua during the latter half of pregnancy, consult W. Hunter, *Anat. of the Gravid Uterus*, tab. xxiv. fig. 3, 4. tab. xxix. fig. 45., comparing with these, tab. xxix. fig. 2."

[f] "This weight and volume are remarkably large in proportion to the mother, if compared with those of the offspring of many other mammalia. But, notwithstanding, woman is so far from producing the largest fœtus in this respect among the mammalia, that she is far surpassed by some, especially of the bisulca, and most by the Guinea-pig." Sir Richard Croft attended a woman whose child was born 15 lbs. in weight; another was born at Penzlaw weighing 20 lbs. (*Dublin Med. Journ.* March, 1838.); on the other hand, the weight at birth has not exceeded 3 lbs.

"The quantity of the liquor amnii is too variable to be defined; but, when the fœtus is strong, it seldom exceeds a pound."

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[g] *Phil. Trans.* 1786.

CHAP. XXXIII.

OF LABOUR AND ITS SEQUELÆ.

"The fœtus, formed by the powers already described, and being now perfect and at the period of maturity, has to come into the world by means of *labour*.[a]

"This critical *period* occurs naturally (and physiology treats solely of natural occurrences) at the end of the tenth lunar month from conception, *i. e.* about the 39th or 40th week" — 280 days.

"At that time, the pregnant woman is impelled to bring forth by an absolute necessity, less under the influence of the will than any other voluntary function.[b]"

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[a] "Fr. B. Osiander, *Handbuch der Entbindungskunst*, t. ii. P. i."

[b] It was formerly believed that pregnancy might be extended to twelve months, and even to two years. With all deductions for error and temptation, I think a few satisfactory modern cases are recorded of its protraction to one, two, and even eight weeks, beyond the fortieth.*

Dr. Merriman has given the dates of the birth of 114 children calculated from the day, inclusively, after the last mark of menstruation. There were 3 births in the 37th week; 13 in the 38th; 14 in the 39th; 33 in the 40th; 22 in the 41st; 15 in the 42d; 10 in the 43d; 4 in the 44th. He vouches for the accuracy of the statement.

Med. Chir. Trans. vol. xviii.

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* See Dr. Smellie's *Treatise on the Theory and Practice of Midwifery;* Dr. Bartley's *Treatise on Forensic Medicine, &c.* Bristol. Foderé declares that to his own certain knowledge his wife went ten months and a fortnight in her two first pregnancies. M. Dulignac, long a surgeon-major, declared on a trial that in regard to his three last children his wife was pregnant thirteen months and two weeks with two, and eleven months with the other; and that he had discovered each of these pregnancies between the fourth and fifth months by the motion of the child, and watched them all to their termination. (Foderé, *Méd. Légale*, t. ii.)

It is ascertained that labour most frequently begins in the evening and ends in the morning; the greatest number of births of both living and dead children taking place in the three first hours after midnight.

"Physiologists have differed in their explanations of the *causes* of so determinate and sudden an event. After all, the *exciting* cause of labour must be ascribed to an established law of nature, hitherto equally inexplicable with so many other *periodical* phenomena; *v.c.* the metamorphosis of insects, the stages of exanthematic fevers, crises, &c. &c.; nor has the mature ovum been inaptly compared, *cæteris paribus*, to fruit, which, when ripe, falls almost spontaneously to the ground, from the constriction of those vessels which previously conveyed its nourishment. And in fact it has been remarked that the human placenta, at the approach of labour, is contracted, and, as it were, prepared for its separation from the uterus." Its changes before birth will be mentioned in the 36th Chapter.

"What is usually urged respecting the utmost expansion of the uterus, and other similar excitements to labour, is refuted by many circumstances, and, among the rest, by the numerous

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It is thought that the uterus is disposed to unburthen itself at what would be a menstrual period, and that labour usually occurs at the 10th menstrual period after impregnation; so that it varies according to the interval between impregnation and the last menstruation, provided impregnation do not happen just before a menstrual period, in which case labour may occur at the eleventh rather than the end of the tenth month. Kluge, who gives formulæ for calculating the duration of pregnancy on these principles, remarks that the Jews considered the period of labour to be the 270th day from conception, because they did not allow connection before the tenth day after the conclusion of the catamenia, nor just before their commencement. (*Medicinische Zeitung von dem Vereine für Heilkunde in Preusse*, 1839, p. 203. Burdach.)

Premature labour independent of external causes, also occurs most frequently at what would be a menstrual period.

That there is great variety among brutes was known to the ancients, but M. Teissier has made very extensive observations on this point: — Of 160 cows, 14 calved from the end of the 8th month to 8 months and 26 days; 3 on the 270th day; 50 from the 270th to the 280th; 68 from the 280th to the 290th; 20 on the 300th; 5 on the 380th. He obtained similar results with 202 mares, 130 sows, and 139 rabbits. M. Darcet found that in the same hen's nest 1 egg hatched on the 13th day; 2 on the 17th; 3 on the 18th; 6 on the 19th. (Foderé, l. c.)

examples of extra-uterine, whether tubal or ovarian, conceptions, in which, at the expiration of ten months from impregnation, the uterus, notwithstanding its vacuity, is seized with the customary, though indeed fruitless, pains.[c]

"Besides this exciting cause, other very powerful *efficient* causes are requisite, as must be manifest from the relation of the ovum to the uterus.[d]

"We are persuaded that the *proximate* and primary cause is solely the *vita propria* of the uterus.

"Among the *remote*, the most important appears to be the respiratory effort excited principally by the great connection[e] of the intercostal nerve with the rest of the nervous system.

"We formerly noticed that, in the latter periods of pregnancy, the uterus somewhat subsided, by which circumstance the form of the abdomen is a little changed and the inconveniences induced during advanced pregnancy in the function of respiration are relieved. At the same time, the vaginal mucus is secreted more abundantly, the vagina itself is relaxed, the columns of rugæ are almost obliterated, and the labia pudendi swell; finally, near the approach of labour, the os uteri gradually dilates into a circular opening;" and even in a case of double uterus the orifice of the empty organ has dilated just as that of the other did while expelling its fœtus.[f]

"The *phenomena* of labour generally observe a regular order of commencement and progress[g], whence accoucheurs have divided them into *stages*, of which the moderns enumerate four or five, although they define them variously.

"In the *first*, the true pains occur, peculiar in their nature, proceeding from the loins in the direction of the lower parts of the uterus (recurring, at intervals, indeed, during the whole of labour, with various degrees of violence and frequency), mild in the beginning, at which time they are called *warning* and the os uteri begins evidently to dilate. The abdomen now falls still more, the urine is urgent, and abundance of mucus flows from the soft and tumid genitals.

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[c] "I have recorded a remarkable instance of this kind in the *Comment. Soc. Scient. Gottingens.* vol. viii."

[d] "Consult J. De Gorter, *De actione viventium particulari*, p. 38."

[e] "*v.* Camper, *Demonst. anat. pathol.* L. ii. p. 9."

[f] Froriep, *Natizien*, vi. p. 229.

[g] "*v.* Smellie, *Set of anatomical tables*, tab. xi.—xv.'

"In the *second*, the pains, increasing, are called *preparing*, and, by the compressing effect of the respiratory organs, a strong inspiration, &c., a segment of the lower part of the membranes of the ovum is protruded through the uterine orifice into the vagina.

"In the *third*, the pains, becoming more excruciating, are called *labour pains*, and act with still more violence upon the uterus, which is driven downwards and compressed against the fœtus, so that the protruded segment of membranes becomes extremely tense, is burst asunder, and the greater part of the liquor amnii escapes."[h]

"Finally, in the *fourth* and last stage, the pains, becoming dreadfully violent and *agitating*[i], are accompanied by great exertions of the woman herself; almost always too by shivering, shrieking, tremor of the knees, &c. The head of the child, now on the verge of birth, penetrates, and the face first appears, the vertex usually remaining under the arch of the pubes, and the rest of the head in the mean time being farther propelled, and revolving around the impacted vertex as around an axis. Thus the child comes into the world, in the midst of a red discharge, consisting of a second portion of the liquor amnii mixed with blood.

"Soon after the expulsion of the child, *the delivery of the secundines* in the *fifth* stage commences, attended by a painful though much less violent exertion, and followed by another hemorrhage from that part of the cavity of the womb[k] to which the placenta had adhered by means of the decidua crassa.[l]

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[h] Sometimes the child is born in the membranes. Wrisberg has observed this to happen three times in 2000 instances. (*Commentationes*, p. 312.) Its cause may be the smallness of the ovum, or the large size and softness of the os uteri. The child is then said to be born with a *caul;* and, as it came into the world under water and yet lived, the caul is superstitiously believed by many to be a preventive against drowning if a person keeps it in his pocket. Cauls are continually advertised for sale, and fetch more if the purchaser can be made to believe farther that the child was a male. The price is a few pounds.

[i] "Although, even among my own countrywomen, the symptoms described under these four stages vary greatly in violence and proportionate duration, nevertheless, however naturally they take place, they universally (excepting some extremely rare cases) so far surpass, even under the most favourable circumstances, the pains experienced by domestic brutes in their labours, that I trust no one, who has frequently witnessed labours in both, will seriously doubt the immense difference between them in this respect."

"Immediately that both burthens are expelled, the uterus begins gradually to contract, until" in about six weeks "it acquires its original form and very nearly its original dimensions."

The ordinary duration of labour is from four to six hours. It may be only one; it may exceed twelve. Madame Lachapelle found that, of 2335 labours, 1476 occupied from 1 to 6 hours; 719 from 7 to 12; 124 from 13 to 24; 15 from 25 to 36; 4 occupied 48, and 1 occupied 60.[m] Mental emotion may suspend the pains for a time, just as it may bring them on before their time.

"For about a week after labour, the *lochia* are discharged, for the most part very similar to the catamenia, but rather more copious, especially if the mother does not suckle her offspring. About the sixth day their red colour becomes fainter, and afterwards changes to white.

"At the same time the uterus is liberated from the remaining shreds of the decidua, and, having thus completed the function of pregnancy, is again ready for menstruation or conception."

The vagina is not only fitted by its rugæ for unfolding under distending causes, but, possessing a fibrous coat under the mucous, appears capable of contracting powerfully like the uterus in labour. The arms or the head remaining in the vagina in breech presentations, and the head when separated from the trunk and lying in the vagina, may be expelled with great force. On abortions also and coagula in the vagina the same observation is made.

The uterus will of course expel the child while the mother is in a state of coma or apparent death. It has contracted powerfully for a quarter of an hour after death.

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[k] "B. S. Albinus, *Tab. uteri gravidi*, vii.

Wm. Hunter, *Anat. of the Gravid Uterus*, tab. x. fig. 3."

[l] "Nic. Massam and all since his time denominate this portion of the interior of the womb, during or shortly after pregnancy, *the cotyledons*, from the analogous appearance observable in the gravid uterus of sheep or goats, in which similar cavities (*acetabula*) exist, receiving what are called the glandular corpuscles of the chorion that correspond with the fœtal portion of the human placenta.

Whatever was hollow, like an acetabulum, was called κοτύλη by the ancients. *Vide* J. Cammerarii *Comm. utriusque linguæ*, p. 256. 384."

[m] *Pratique des Accouchemens.* Paris, 1825.

Women may die in parturition, but far more die after it. Fatality is proportionate to the unhealthy circumstances of individuals; so that fewer die now in most European countries than formerly.

Labour is much more easy and sooner recovered from, the greater the purity of the atmosphere and the food, and the more natural the mode of life; more easy among the lower classes who are in fair circumstances than the highest. The Indian women of South America, if taken in labour on a journey, are said to retire to a thicket, bring forth, wash themselves with water or melted snow, take up their load again, weighing perhaps 80 lb., put their child on the top of it, wrapped in skin, and rejoin their companions. Only a short time ago a poor servant of all work in my neighbourhood delivered herself of a child in the night at full time, went down to her work as usual in the morning, would walk to the police office, and on being taken to prison mixed with other prisoners, allowing herself no indulgence[n]; and she did very well.

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[n] Barbarous and semibarbarous nations have very properly regarded a puerperal woman as impure for various lengths of time, and some have insisted upon purification before allowing her to enter a temple, walk in public, or approach her husband. Some Tatars purify her with prayers and baths. (Zimmermann, *Taschenbuch der Reisen*, t. viii. p. 122.): the Samoiedes with castor and hairs of reindeer, and they compel her to pass into the fire. (*Ib.* p. 164.) At Siam and Pegu, she remains by the fire above a week for purification. (Frank, *System der Medicinischen Polizei*, t. i. p. 646.) The Hottentots, having no eau de Cologne, purify her by sprinkling her with urine and rubbing her with cow-dung. (Demeunier, *Ueber Sitten und Gebræuche der Voelker*, t. i. p. 44.) The Jews regarded her impure for a week if she had produced a boy, and for a fortnight if a girl; she was not allowed to enter the temple for 66 days after the birth of a girl, though at the end of 33 days after the birth of a boy. This distinction was no compliment to the female sex; nor is the reason obvious, unless boys were more prized and it was thought that impressions on the mind assisted in determining the sex. This inconvenience after delivery was, however, compensated for by a great indulgence during it: for while pregnant they were allowed a luxury which every good Christian must pity the Jews for being deprived of,—pork. Women of the Church of England are *churched* as soon as they go out, and without reference to the sex of their production. I have known them, however, through favour, be *churched at home*. A droll custom among many nations of Europe, Asia, and South America, is to make the husband be confined, keeping his bed, abstaining from work, and from his usual food and smoking, and covered up as if

Delivery stands on the same footing with defecation. Nature is sufficient in the immense majority of instances, and scientific assistance is no more required than in the visit to the water-closet. Yet as sound knowledge and art may be required by the condition of the bowels, so the obstetric art is of the highest importance; and, in spite of it, parturition, like disordered defecation, is sometimes fatal. The proportion of fatality in different European cities is one in from 150 to 200 cases; but must vary according to the healthiness of the mode of life and the freedom from absurd practices with puerperal women. It is consequently less in Europe now than formerly. The first labour more frequently requires the assistance of art than any other. Riecke says that one of seventeen cases requiring art is the first labour.[o]

If there is a second child, it is generally expelled immediately after the first: but some hours may intervene; and even eleven days have passed before the second birth, though at full time. Sometimes the first is discharged at an early period of pregnancy, and the other remains longer, perhaps the full time. Sometimes the first is blighted, and either discharged early, or with the other at the end of the forty weeks.

It is probable that uncivilised women would naturally bite or tear with their fingers through the chord; a lacerated wound affording the greatest impediment to hæmorrhage. The Boshman[p] and Brazilian[q] women are in fact said to bite it asunder. A woman is not likely to do this till some minutes have elapsed and allowed her to recover a little from her exhaustion, and by that time the

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he were sick. It arises from a fancied connection between the life of the father and child, so that if the child dies the father bears the blame. I have not known a man persuaded he was with child, like Calandrino, in Boccaccio, but have more than once known the husband of a pregnant woman believe he was breeding for his wife: that is, ascribe various dyspeptic and nervous symptoms in himself, while his wife was hearty, to the breeding symptoms having gone over from her to him. The Brazilians, according to Spix and Martius (*Reise in Brazilien*, p. 381.), have some such fancies of sympathy between man and wife, for during pregnancy the man as well as the woman abstain from certain sorts of meat, and live chiefly on fish and fruit. For references to travellers, see Burdach, § 574.

[o] *Beiträge zur geburtshülfliche Topographie*, p. 32.

[p] Virey, *Hist. du Genre Humain*, t. i. p. 328.

[q] Spix and Martius, ib.

pulsation of the chord would have wholly ceased. Neither is she likely to lacerate it so near the umbilicus as we for subsequent convenience divide it: but more nearly midway, so that the longer extent of shrinking of the vessels would offer still greater obstruction. Brutes who bring forth lying tear through the chord with their teeth; with those who stand during their delivery it snaps asunder, and usually near the placenta, where its vital powers have begun to decline; there being usually no hæmorrhage, as their placenta is so much more reduced in vitality at full time than that of women. The human chord may snap if the woman is standing, or if it is short, or dry and brittle, or when the child is forced away too quickly. In civilised life the chord is cut a few inches below the navel and tied. If the child is perfectly mature, and the division made at a proper distance from the navel, there is little chance of hæmorrhage beyond half an ounce to an ounce, because the blood will cease to circulate in the placenta and umbilical arteries, and flow freely into the lungs. But, as we are not always certain of this, and hæmorrhage may occur sometimes, and especially since we cut the chord clean and do not make a lacerated division of it, it is safe and right to tie the chord[r]: and, as it is possible that there is a second child and but one placenta, it is a proper rule to tie it in two places and divide between them. The portion attached to the navel dries up by the third day, from the absorption of its fluids into the child: its vessels are indeed not permeable after the first day. The portion attached to the placenta does not dry up, but putrefies. Four or five days after birth, the shrivelled piece of chord drops off like a gangrenous part, the living part immediately beyond it having liquefied and been absorbed. In from a week to a fortnight the opening at the navel closes. When the chord drops off, the opening which is left becomes closed completely by the constriction of the tendinous fibres surrounding it. A central depression is thus produced, on which skin forms, adhering to the linea alba, and on which no fat is deposited, so that a depression is permanently left.

During pain the placental sound is duller and less frequent, and the action of the fœtal heart is weaker and less frequent in proportion to the violence of the pain.

Any part of the fœtus may present itself at the os uteri. But the presentation of the head is the ordinary and normal. This fact has been shown by M. Dubois to be independent of gravity. M. Virey has demonstrated the same thing in regard to animals in general. The chord is frequently coiled round the neck; sometimes the placenta is attached to the margin of the os uteri: yet the head is the lowest part and at the os uteri, as regularly as if the fœtus had been suspended from the placenta by the chord. M. Virey states that, if female quadrupeds are examined at different periods of gestation, the head of the embryos and fœtuses are found, with very rare exceptions, whether in the horns or body of the uterus, directed towards the vagina; one following the other like a pack of hounds, in one track. The head escapes the first from the eggs of the bird, reptile, and insect; the head of the chick is directed to the large end of the egg, which is more fragile, and more permeable to air; and the large end of the egg is directed towards the oviduct even before impregnation. Fish, and among vermes at any rate the leech, are known to be born head foremost. The head of the fissiparous and gemmiparous animals is the first part developed. This is a law, and analogous to that of the ascent of the plumula and descent of the radicle in vegetables.[s]

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[r] This point will be spoken of again in Chap. XXXVI.

The new being is frequently expelled before the proper time, and some say that this happens in the case of girls more frequently than of boys.[t] When there are twins, labour generally begins earlier; and the period of pregnancy is generally much shortened by the presence of three or more fœtuses. The term *abortion* is given to its expulsion before the completion of the sixteenth week: *miscarriage* to its expulsion between this period and the completion of the twenty-eighth week; and *premature labour* to its expulsion between the twenty-eighth week and the full term. These accidents occur more frequently in the early than the late periods of pregnancy, on account of the smaller extent and greater delicacy of

[s] See M. Dubois, *Mémoires de l'Acad. de Médecine*, 1833.

[t] Sömmerring, *Icones embryonum*, p. 2. Autenrieth, *Supplementa ad historiam embryonis*, p. 59. Some maintain that girls are born earlier than boys, when born about the full time. Of the 16,617 births at the Dublin Lying-in Hospital, mentioned *suprà*, p. 796., the premature were 498; and of these the males were 255, and the first births 172. The premature twins were 54.

attachment of the contents to the uterus and the greater susceptibility of injury in every point of the ovum in proportion as the period is earlier.

Premature expulsion may arise from mechanical violence, emotion of mind, and whatever else can irritate the womb, injure the connection between it and its contents, or impair their vital powers. Whatever produces hæmorrhage into the amnion or among the membranes may act in all these ways. Original weakness of the powers of developement, vitality becoming soon exhausted, may have this effect. It is therefore not uncommon to see monstrous embryos and fœtuses in abortions and miscarriages, or even membranes with no embryo. When the ovum has lost its powers, it is felt as a foreign body.

The uterus sometimes acquires a habit of premature discharge.

Occasionally a solid substance is discharged with no trace of fœtus, appearing to be only diseased membranes, and is termed a mole or false conception.

If the placenta is not expelled after the child, in very rare instances it is absorbed, but in general it soon putrefies; except in the case of abortion, and after this it has remained weeks and even months without putrefying.

M. Velpeau remarks that it is not a matter of indifference what part of the ovum first enters the uterus. If the part of the chorion on which the chord is inserted enters last and rests completely in the angle of the uterus and in the middle of the circle of the decidua, the placenta will assume a more or less circular form. If, on the other hand, it enters first, or is displaced so as to be completely in apposition every where with the decidua reflexa, its vessels will not be developed, and the ovum dies and is expelled, or a mole is produced and spurious pregnancy ensues; and if the same point is very near the circumference of the circle of reflexion, the umbilical vessels will be developed towards the part only where the uterus or rather the decidua crassa is partially in contact with the ovum, and so the placenta will take the shape of a racket, &c.

A child seldom lives if born before the seventh month is completed: yet has been said to have occasionally lived when born at the end of the fifth.[u]

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[u] *Edinb. Med. and Surg. Journ.* vol. xi. xii.

The ovum sometimes halts in the Fallopian tube; sometimes is retained in the ovary; sometimes escapes into the peritoneal cavity; and has been found in the walls of the uterus[x]: growing by means of a placenta[y] a longer or shorter time in these situations, the frequency of which is in the order in which I have mentioned them. Not only does the placenta derive nourishment from the mother's vessels in those situations, just as from the uterine vessels in normal pregnancy, but the chorion before it forms the fœtal placenta imbibes nourishment from the fluids of the peritoneum, as it does naturally in the generative organs. For example: Mayer saw an ovum with a perfectly developed embryo and fœtal placenta in the peritoneal cavity of a doe rabbit, without the slightest connection with the blood-vessels of the mother,—a proof that the peritoneal serous exhalation was sufficient for nutrition and developement.[z]

Such pregnancies are termed extra-uterine. The uterus slightly enlarges: a decidua usually forms in it[a]: and the pains of labour take place at the full time, as if the ovum had descended into the womb. Death is the usual result. If the ovary is the seat, this usually bursts before the sixth or seventh month begins; if the Fallopian tube, this usually gives way within six weeks or two months[b]: in the peritoneum the fœtus may remain even beyond the full time, and even another child be engendered and born. In the four cases of pregnancy in the substance of the womb, the duration did not exceed three months. Occasionally a strong cyst forms around the membranes in the case of ovarian and peritoneal pregnancy, as well as when the fœtus has escaped into the peritoneum after staying some time in the ovary or tube, and the patient lives many, even fifty[c] years; suppuration at length most frequently takes place, in some direction or other, bone and other portions of the fœtus being slowly discharged. I frequently saw an old woman at Balham in Surry, who, for years, had been discharging very fœtid portions of a fœtus conceived twenty years before. The fœtus may still live at a very low degree; for in such cases the teeth have been developed, the ribs anchylosed with the vertebræ, &c. M. Schmidt relates a case, believed by Burdach, of abdominal pregnancy, in which the child was cut out at the end of two years, breathed and lived two hours.[d] After remaining several years, some teeth may acquire the adult size, and the hair great length. Sometimes absorption takes place to a great extent: just as a retained placenta is sometimes absorbed. Sometimes the fœtus dries up. I may mention that a fœtus has been retained 42 years in the uterus, when for some reason or other, generally retroversion of the uterus, it could not be expelled. It has become encased in various formations, even in bone, in these cases, as well as in extra-uterine pregnancy, and itself has been converted to bone.

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[x] Dr. Breschet, *Med. Chir. Trans.* vol. xiii.

[y] *Deutch. Archiv.* t. iii. p. 145. If the egg of a bird falls into the peritoneum, it acquires a white, just as if it was in the oviduct.

[z] *Deutches Archiv.* t. iii. p. 145. Burdach believes the case.

[a] A decidua sometimes forms in the unimpregnated cornu, when the other is impregnated, in cases of double uterus. *Med. Chir. Trans.* vol. xvii.

[b] See a case described by myself in the *Med. Chir. Trans.* vol. xiii.

[c] *Med. and Phys. Journal,* May, 1800.

Labour is the process of separation of the offspring from the parent, and occurs at very different periods of embryonic existence. In some entozoa and mollusca, and in most fish, and among the Batrachians, the germ is discharged before it is fecundated. In most other oviparous animals, the separation occurs as a sowing —a semination—the ovum after being fecundated is discharged for hatching or incubation. In vegetables which produce grains, the separation occurs when developement has proceeded some way, and incubation is completed in the ground. In mammalia * labour takes place still later — when the fœtus is complete and ceases to be such, entering upon independent existence. In the ovo-viparous, labour is later, for, after the offspring has left the shell and fœtal existence, it remains some time in the parent. In generation by splitting, buds, tubercles, and bulbs, the new system does not leave the parent till it has the vital conditions and in part the size of the parent. (Burdach, § 479.)

The first bulb, or sucker, of vegetables, separates only by an atrophy of the parts connecting it with the parent; in animal fissiparous and gemmiparous generation, a similar circumstance occurs, but movements of the new animal, or of the new and old animal, at length complete the separation. In those vegetables which produce the new plant in their interior, and in some of the lowest animals, the *spore* escapes by laceration or mortification, and in some the parent always perishes in consequence. The Volvox globator and Amphistoma cornutum perish after being lacerated by the exit of the young or eggs. Some confervæ must perish and dissolve before their spores can escape. In higher animals, besides the reduced activity of life at the full time in the maternal and fœtal parts which are in connection, muscular power is given to the receptacles to propel through natural openings, aided by voluntary muscles: though these are not indispensable, since the uterus has expelled the child when the mother was in syncope or asphyxia.

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[d] *Beobachtung. der Akademie zu Wien.* p. 84.

* I always employ the classical term *mammalia*, and not *mammifera*, which has been coined by the French without any necessity.

Some animals have a certain amount of voluntary power over labour. The cuckoo and meat-fly lay their eggs, the former when it finds a nest left by a hedgesparrow, the latter when it finds some dead flesh. Moral causes will arrest, just as they will excite, labour. Some brutes require an accoucheur. The male *green frog* presses the fore part of the female body with his paws till he squeezes the eggs out of the ovary and along the duct, but his assistance is no further required. The male *obstetrical toad* draws the eggs out of the female in a train of mucus with his paws, and is so attentive to his duty that he may be easily caught while attending the case. In some animals, the young help to make their own way out when an opening is afforded them.

Mammal brutes bring forth, like the human race, in *labour* and sorrow: and more so if they are deprived of free exercise and open air. The labour and sorrow arise of course, like the pain of teething in innocent babies, from the necessary construction and properties of the system,—the anatomy and physiology necessary to render each being what it is, — upon the original laws of the universe, like the appearance of the rainbow. The other classes, equal in innocence to the mammalia, suffer far less, or, like vegetables, not at all, and simply from their anatomy and physiology being different.

The compression of the offspring from the difficulty of delivery is thought to be highly beneficial. Jerg (*Ueber das Leben des Kindes*, p. 68.) asserts that children easily born breathe but superficially, and frequently die within the first eight days, exhibiting after death lungs incompletely distended: and Burdach remarks that, though the Journals are filled with accounts of successful Cæsarian operations, it is difficult to find individuals who have been thus easily brought into the world. (l. c. § 496.)

Some herbivorous animals frequently devour their placenta*, and sometimes the mother morbidly devours her young. The latter circumstance has occurred repeatedly with the same individual, and then probably resulted from a morbid state of feeling, — a monomania. Sometimes the mother devours her young from intense hunger after delivery, as in the case of the ferret and sow: and hungry insects will devour their larvæ. Wild animals in captivity, though well fed, often devour their young; the same thing happens occasionally if these are too numerous for her to feed, or if they are monstrous in form.

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* The Brazilians and Jacuts are said to do the same. Among the Tonguses the placenta is appropriated as a tit-bit to the worthy man who was at the trouble of getting the lady in the family way. He roasts it, and either eats it all himself or invites the most select among his friends to have a taste with him. (Zimmermann, *Taschenbuch der Reisen*, t. vii. p. 97.)

The ovum after its fecundation may be nourished by a fluid enclosed within the same case, and is then hatched out of the body by the common temperature, as in insects, or by that of the parent, as in birds, or hatched within the body of the mother, as in serpents; or it may be nourished by a substance shed around it in the womb, as in the kangaroo and other marsupials, for a short time, after which the young one finds its way into the pouch and attaches its mouth to a nipple, which it never finds again if once dislodged, or by means of an attachment of some of its vessels to the maternal system, as in the mammalia in general: — some animals being thus oviparous, others ovo-viviparous, and others viviparous, or more properly, as Burdach remarks, nudiparous and ovo-nudiparous. The plant louse is ovo-viviparous in spring, and oviparous in winter, its young not being hatched till the cold weather is passed. Wherever the growth of the ovum takes place after it has quitted the ovarium, whether in an uterus or out of the body, the period is equally that of incubation till the new being leaves the envelopes of the ovum.

As a general rule, the higher the animal, the more share do other parts than the ovarium take in its formation. Some animal ova hatch out of the body without any farther attention of the parent than the instinctive act of depositing them in a suitable situation, or in one from which they may be transported to a suitable situation. Some have no power of remaining long in possession of life, and they are deposited at a period of the year when circumstances are proper for their developement. Others have a great retention of vitality, and are discharged at a season of the year when nothing favours their developement. As vegetable ova,—seeds, are more exposed to unfavourable accidents, they retain the power of developement far longer than animal ova. No animal ovum retains it two years: but seeds have germinated on being placed in the ground at the end of centuries. This retention of life, and the immense number of seeds produced, compensate in some measure for the uncertainty of many seeds ever being placed in favourable circumstances. For the distribution of some is left to the wind; of others to currents of water; of others to the chance of adhering by crotchets on their surface to the bodies of animals; or of being swallowed and passed along the alimentary canal of animals for transportation. The ova of some animals are transported in the same ways.* But after all an infinity of eggs and seeds are constantly perishing. The parent of some species prepares a warm receptacle for the ova, of infinite variety, and placed in the most favourable situation, according to the variety of necessity; and in many instances keeps them warm with her own body, on the abdomen of which a higher temperature than usual may be observed. Sometimes both parents sit on the nest in turn. Some lay their eggs in the nest of another bird. Some build a nest in common for several families. The albatros divide a spot among them into squares, in each of which one builds a nest, and which communicate by paths, and are surrounded by a path covered with stone. The ova of some animals are attached for a time to their surface, either bare and by mucus, or enclosed in cells, which form in the skin, as is observed in the Surinam toad, or in a pouch which adheres by mucus to the abdomen or back and may be made instinctively by the animal.

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* While going my round at University College Hospital in the summer of 1838, a shower of frogs fell in the street—Gower Street: and many letters have been addressed to the French Institute from indisputable witnesses of showers of frogs and toads that fell on umbrellas, hats, or outspread handkerchiefs. They are thought to be hatched in a cloud from spawn raised with the water of marshes by solar evaporation, or by the whirlwind which precedes water-spouts in the heat of summer. M. Arago favours this latter explanation. (*Révue Méd.* Nov. 1831.)

Of course, if an animal ovum or a seed dies, it cannot be quickened or come up; and it rots like a dead animal or plant. They hatch or spring up only when they have not ceased to live. They are killed if thoroughly deprived of moisture or of air by being smeared with grease or oil or kept several days in vacuo: or of their proper temperature by being long exposed to a very low or high temperature: or if exposed to a strong electric shock, or if much shaken, or pierced with a needle. Actions, therefore, go on: and indeed an egg, not hatching, has been found by Dr. Prout to lose a grain daily, till at the end of a month it had lost 35 grains. The eggs of a pheasant require to be carried in the hand when removed, so delicate is the arrangement of their constituents.

An egg retains its vitality the longer, the less it can waste. Dr. Edwards, I mentioned at p. 278. *suprà*, ascribes the circumstance of frogs and toads living so long enclosed in trunks of trees and blocks of wood to the admission of air being just sufficient to support life, but insufficient to allow much respiration. The seeds which have lived for ages have been found in sarcophagi: some enclosed frogs and toads may have been hatched in the wood or stone, the ovum having retained its life for the same reason and passed through its various stages of developement in the slowest possible manner. Dwight says he saw an insect, the egg of which had been enclosed in the trunk of a tree eighty years and hatched on being brought into the air and light. I also mentioned at p. 232. that eggs are cooled and frozen with more difficulty than equal masses of inanimate matter: and eggs killed in any of the ways just mentioned are heated and cooled much more easily than those which are fit for hatching.

In many quadrupeds circular or oval portions of the inner surface of the uterus enlarge into spongy masses termed *cotyledons*, from which a milky fluid may be squeezed. Corresponding vascular efflorescences of the chorion meet and unite with these, and thus a connection is established between mother and child. At birth they separate; the fœtal portion passes away with the membranes, of which it is really a part, and the maternal shrinks and is absorbed as the uterus decreases.

When a bird's egg enters the oviduct, it has neither white nor shell, and sometimes eggs are accidentally discharged from the body before they acquire a shell, and are then called wind-eggs. The yelk is covered by two membranes, one within the other, and both well supplied with a network of blood-vessels. But the yelk does not adhere to the inner membrane with which it is in contact. Below the internal is a third without blood-vessels, called vitellary membrane, which gradually disappears during incubation. Under this transparent membrane, but, according to Dutrochet, unconnected with it, opposite the side where the ovum was attached to the ovary, and in a small aperture at the summit of a thick opake spot (stratum proligerum — composed of discus proligerus and tuberculum proligerum or cumulus) of the inner membrane, called *cicatricula*, lies the germinal vesicle (vesicula proligera), which, or its contents, or both, or, as was said before the appearance of Dr. M. Barry's paper, both now united with the stratum proligerum into the germinal membrane, becomes the embryo: the germs of plants are equally unconnected with their capsules, and therefore with the seed organs. The ovum escapes through the two outer membranes into the oviduct. The inner membrane, however, is soon furnished with a coat secreted by the duct. This is termed the yelk bag or chalaziferous membrane, and has a small knob at each end called *chalaza*, which extends into and terminates in the white. The egg advances along the tube and becomes, as in the mollusca, arachnides, crustacea, reptiles, and many fish, imbedded in the white or *albumen* that is furnished by the tube and fills it. Around the white another membrane forms, which becomes attached to the two chalazæ. Another membrane next forms around this, consisting of two layers; and the egg, having now passed along half the duct, acquires a shell during the rest of its course. Harvey discovered that the white is double, one portion placed outside the other and thinner. Each portion remains distinct, though not separated by a membrane. It is to the yelk as 604 to 288, and consists of 0·155 albumen, 0·045 mucus, and 0·800 water. The chalazæ are always very near the poles of the egg: the cicatricula at the equator, and always uppermost, in the most favourable situation for receiving the mother's warmth, on account of the opposite part being the heaviest. The chalazæ, being lighter, says Derham, than the white in which they swim, and placed rather out of the axis of the egg, cause one side of the yelk which they suspend to be heavier than the other. The two layers of the lining membrane of the shell are separated at the large end and leave a space, the walls of which are called *folliculus aeris*, from the circumstance of its containing air. The germinal membrane is about $\frac{1}{6}$ of an inch in diameter, and at the central part is the thinnest and called *colliquamentum*. After impregnation, a dark line is seen on the germinal membrane, called the *primitive trace*, and the germinal membrane expands, grows thicker, separates into two layers, between which a third, called *vascular*, appears. The external or *serous* gives rise to the osseous, nervous, muscular, and tegumentary systems; the internal, called *mucous*, uniting with the central, gives origin to the respiratory, intestinal, and glandular systems. These layers gradually expand more and more over the yelk. The yelk bag corresponds with the vesicula umbilicalis of the mammal fœtus, and the yelk is for the nutrition of the new being at birth: but, while it is considerable in birds, as the new being possesses little other nourishment, it is very small in mammals, and these are nourished through the means of a placenta or marsupial teats, and therefore the vesicula umbilicalis is smaller and disappears early. The yelk or primary embryotrophe consists, according to Dr. Prout, of 0·29 of oil, 0·17 of albumen, and 0·54 of water: the oil contains phosphorus, and may be reduced to elaine, stearine, and a crystalline, unsapifiable fat, like cholesterine. It is at first transparent, then becomes turbid, then white and milky, and ultimately yellow and viscid. The white or secondary embryotrophe contains, according to Dr. Bostock, 15·5 of albumen, 4·5 of uncoagulable matter, and 80 of water. According to Dr. Prout it contains the same inorganic principles as the yelk, but more sulphur and hydrochlorate of lime and magnesia, and less phosphorus and hydrochlorate of potass and soda. It is consumed in most oviparous animals before the yelk. According to Dr. Prout, the fresh egg of a fowl contains 0·288 of yelk, and 0·604 of white, and at the end of incubation still 0·167 of yelk, whereas a mere membranous coagulum remains of the white: and the oil of the yelk is the part consumed the last. (*Phil. Trans.* 1822.) The yelk differs from the white in the presence of fatty oil, and a greater proportion of phosphorus and neutral salts, chiefly, and comes into use when this is exhausted, and strong nourishment and stimulus are required. The importance of the white is shown by its more immediately receiving air and external heat; by the brain and spinal chord — the primordial organs containing a superabundance of albumen and being developed at that part turned towards the white; and it is conjectured that the reason of this organ being less developed in invertebrate animals is that it arises at the inner surface of the serous layer, whereas in the vertebrate it arises at the outside, separated from the white by the delicate vitellary membrane only. (Burdach, § 463.) The fresh egg of a fowl weighs usually from 1½ ounce to 2 ounces — from 720 to 790 grains; and loses about ⅙ of its weight in hatching, from the evaporation of its water, chiefly through the heat of the mother and chemical changes, for it loses not so much by four fifths to seven eighths if left merely in the air for the same time; and, if not first impregnated, loses but 125 grains though kept under the hen. When incubation begins, the concentric layers of liquefied yelk are seen around the disk of the proligerous membrane, and are called *halos;* the yelk augments in quantity, and liquefies more and more. Dr. Prout has shown that it obtains salts and water from the white, and furnishes oil to this, which also becomes more liquid and lessens in quantity Though no fibrin, mucus, gelatine, hæmatosine, &c. are to be detected in either yelk or white, these are all found in the embryo. The sulphur, phosphorus, and alcaline muriates of the egg and chick, at the end of incubation, are greater, and the lime less, in quantity than in the newly laid egg. Where the former have gone, and whence the latter is derived, is not known. Lassaigne found ten times more lime in the chicken just hatched than in the new laid egg of the same hen. (*Journal de Chimie Médicale,* t. x. p. 195.) An egg, if laid before it is impregnated, soon dies with the warmth of the nest which hatches those which have been impregnated.

The eggs of fish have a hard and sometimes a horny covering, and some are quadrangular. The eggs of serpents are nearly similar. In insects there is no secondary embryotrophe, because the essential parts of the ovum are formed in the ovarium.

The young of oviparous animals break an opening in their enclosure, and let themselves out. Every one knows that the chicken chips the shell. The coverings always grow thinner or more brittle beforehand. The eggs of many distomata have a little lid, which the young one raises in order to escape. If the egg is deposited deep, and there are many, the parent, as the Apis violacea for instance, prepares a canal leading in the opposite direction, from the course of the first egg, so that the first may at once escape, and the others follow in succession. If the last laid egg chance to hatch the first, its young makes its way through the other cells to the canal of exit, killing the chrysalides as it goes. The parent sometimes chips the shell for the young: working bees raise the lid of wax when the young are fit to leave the cells; and the working ants tear with their jaws the part of the chrysalis corresponding to the head of the young one, knowing, by some means mysterious to us, when the new animal is fit to be set at liberty. Humboldt says that crocodiles, which do not hatch their eggs, return to them at the proper time and help the young ones out. (Burdach, § 498.)

The number of offspring produced at a birth, and the number produced during life, is enormously various. Some produce but one or two, and remain pregnant the greater part of a year, or even more; while others produce swarms, and are pregnant but for a portion of a day. The female flesh-fly prod 20,000 larvæ at a time: and there is not unfrequently a third generation in three days; and therefore Linnæus computed that the carcase of a lion may be devoured faster by them than by a lion. The queen bee lays 12,000,000 eggs in twenty days of spring; the female ant lays 80,000 eggs a day; the plant louse may become the progenitor of nearly 6,000,000,000 in five generations. As to vegetables, a plant of common red wheat tillered so much that in August it was divided into eighteen plants. So many of them multiplied in September and October, that sixty-seven plants were separately set out to stand the winter; in March and April they were divided again into 500. These produced 21,109 ears; and the grains were estimated at 576,840. (*Phil. Trans.* vol. lvii.) A single plant of hyoscyamus produces more than 50,000 seeds, so that in four years the whole earth would be insufficient for its produce, if it met with no opposition.

In the wonderful world of insects, generation depends much, in some instances, upon national circumstances. In a hive of bees, for example, but one female has her sexual organs developed and breeds: the others of her sex labour only; unless she dies, when the hive feed up another with a richer sort of honey which brings out the organs, and she becomes the new queen and breeds. A smaller number of the hive are males, and do no work, but are destined solely to impregnate the queen, and her successors in case of her death. And this indeed is a serious business. The queen, a few days after her birth, takes an airing, in which she is sure to meet with one of her swains, and he generally leaves his organs in her and dies of his laceration in half an hour. Happily, however, this single embrace impregnates all the eggs for two years or perhaps for life, though she lays about 1500 a month all the year round.

The vegetable embryotrophe is solid, not, like the animal, liquid or soft: but hard and solid as are the contents of seed, its embryotrophe liquefies when the embryo begins to grow: plants are altogether more solid as well as more fixed than animals. The seeds of vegetables have within their membranous covering two or more lobes called cotyledons; and between these at the margin is the cicatricula or corculum. This, during incubation, sends upwards a shoot called *plumula*, and another downwards called *radicle.* Till the roots and leaves support it, the cotyledons give it nourishment in many instances, and, rising out of the earth under the name of seed leaves, likewise perform the office of respiratory organs. The substance of the cotyledons may be farinaceous, oily, or both farinaceous and oily. Seeds are sometimes enveloped in a dry pericarpium, which bursts when they lie in the earth. Some have a hard shell. Around the outer covering a quantity of soft nourishment may exist, as seen in stone fruit and nuts; vessels passing through the shell or stone from this to the kernel or lobes. This nutriment may be farinaceous and taste like gingerbread, as in the rhamnus lotus; succulent, as in the apple and pear; creamy or medullary in appearance; mucilaginous, as in the gooseberry; pulpy, as in the orange.

It is very singular, but the spores of some vegetables, and of zoophytes which live fixed, exhibit very rapid movements.

The more delicate the plants, the more easily are the seeds killed from which they would have sprung: hence old seed is preferred, since the weakest has generally perished. After a time all seed dies, and will not come up if sown. It appears that changes of perfection are constantly going on for a time in some seeds, for those of linseed and melon give more vigorous plants if sown late. The delay of favourable circumstances beyond a certain time causes developement to be impaired: for the chick is developed much more quickly if an egg is placed under the hen as soon as it is laid. The animation of seeds may be suspended like that of animals. Saussure dried grains which had begun to germinate, and found them begin to germinate again on being moistened. The lowest plants, as the grasses, supported this suspension the best. The less the germination had advanced, the more easily was the exsiccation recovered from; just as the unimpregnated eggs of a fowl keep better than those which have been impregnated, because the power of life depends then upon a less complicated condition. The destruction of the life of an egg before the commencement of developement enables it in the same way to keep longer; but the destruction of its life after the commencement does not enable it to keep. (Burdach, l. c. § 330.)

CHAP. XXXIV.

OF THE MILK.

"The *breasts*, most sacred fountains, and, as Gellius Favorinus the philosopher elegantly calls them, the rearers (*educatores*) of the human race, are intimately connected with the uterus in various ways.[a] The functions of neither can properly be said to exist during infancy; at puberty, both begin to flourish, — when the catamenia appear, the breasts assume some degree of plumpness; from that period they undergo either simultaneous changes — the breasts beginning to swell and secrete milk during the pregnancy of the womb; or alternate changes, — the catamenia ceasing while the child is suckled, or the lochia becoming copious if the child is not suckled, and so on. Finally, when age creeps on, the function of each absolutely ceases, — when the catamenia disappear, both the uterus and the breasts become equally inert. I omit pathological phenomena; *v. c.* those which occur in irregular menstruation, leucorrhœa, after extirpation of the ovaria, and in other morbid affections.[b]

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[a] Women, it is said, have had three, four, and even five breasts: in triangular arrangement; one under another on one side, or on both sides; all in a line; the supernumerary ones on the back; or, in the case where there were five, one under another on each side, and the fifth below all, and in the centre, five inches above the navel. (*Dictionnaire des Sciences Médic.* art. *Cas rares.* An instance of four in London has been just published by Dr. R. Lee in the *Med. Chir. Trans.* vol. xxiv.)

A woman at Marseilles had a third perfect breast, four inches below the great trochanter of the left thigh. This gave milk like the other two; and, though she never had but one child, she continued a wet-nurse for six years. Her own child sucked this femoral breast for three and thirty months, putting his little head under his mother's petticoats and standing or kneeling during the business. This woman's mother had also a third breast, but it was placed on the left side of the chest, and was sucked in common with the others by seven children. (Magendie's *Journal de Physiologie*, Janvier, 1827.)

Tiedemann (*Zeitschrift für Physiologie*, p. 110.) mentions that he saw a woman with two nipples and areolæ in her left breast; and two other analogous instances have been seen in Dublin (*Dublin Journal of Med. and Chem. Sc.* July, 1834). Milk was secreted from both nipples equally.

I am not acquainted with the dissection of any such cases, but, if it is not probable that in the case of the femoral breast a direct anastomosis exists between the uterine vessels and those of this breast, the influence, presently alluded to, of the arterial communication in ordinary cases may appear still further improbable.

The case reminds me of a monstrosity in the same situation as this,—the thigh of a boy, aged fourteen; seen by Zacchias's friend, Balthassar Bonannus, "vir humanitate et doctrina insignis." (*Quæst. Med. Legales*, p. 503.) But instead of a breast, there was a female pudendum,—labia, hair, and rima: on separating the labia, no opening appeared.

"If this intimate connection is kept in view, we shall not be astonished that nearly every description of sympathy exists between these organs of the female thorax and abdomen.[c]

"The influence of the anastomotic sympathy between the internal mammary and epigastric artery[d], although formerly overrated[e], is evinced by the change which the latter experiences in its diameter during pregnancy and suckling.

"Both the uterus and mammæ appear to have a kind of affinity for the chyle, observable in many diseases, and nearly always in new-born children.

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[b] A case is related of a woman whose breasts always poured forth milk in the midst of her connubial bliss. (*Dict. des Sc. Médicales,* t. i. p. 394.) A very disagreeable circumstance is recorded in the German *Ephemerides,* 1670, dec. 1. an. 1.; for a woman always vomited a thin white fluid in her husband's face at the height of rapture, whatever was the hour of indulgence and whether her stomach was full or empty, ("quotiescunque sive nocte, sive mane, aut interdiu, jejuno, aut pleno ventriculo, venerem exerceret,") and she was so amorous that the poor fellow feared she would wear him out, and consulted the writer — Dr. Hertod. ("Honestam matronam," "cæterum salacem valde, et quæ consuetudinem mariti" "plurimum appetebat, prout ipse mihi questus est, et ne in maritali officio tandem succumberet, rogavit.") She was therefore clearly not sick of her husband, though sick through him.

[c] "J. Anemaet, *De mirabili quæ mammas inter et uterum intercedit sympathia.* LB. 1784. 4to."

[d] "Eustachius, tab. xxvii. fig. 12.
Haller, *Icon. anat.* fasc. vi. tab. i."

[e] "As G. R. Boehmer properly remarks, *De consensu uteri cum mammis caussa actis dubia.* Lips. 1750. 4to."

"The *breast* of woman[f], belonging to the most characteristic marks of the human female both by its form during the flower of age and by the longer continuance of this form after the period of suckling than occurs in any other female animal, is composed of a placentiform series of conglomerate glands, divided by numerous furrows into larger lobes, and, as it were, buried in a mass of fat; the anterior part swells out particularly with a firmer description of fat over which the skin is exceedingly thin.

"Each of these lobes is composed of still smaller lobes, and these of acini, as they are termed, to which the extreme radicles[g] of the *lactiferous ducts*," in the form of oblong vesicles, "adhere, deriving a chylous fluid from the ultimate twigs of the internal mammary arteries.

"These radicles, gradually uniting[h], form large trunks, corresponding in number with the lobes,—fifteen or more in each breast. These are every where dilated into large sinuses, but have no true anastomosis with each other.[i]

"These trunks terminate in very delicate excretory canals, that are collected, towards the centre, by means of cellular substance, into the *nipple*[k], which, supplied with extremely fine blood-vessels and nerves, is capable of a peculiar erection on the approach of certain external stimuli.

"The nipple is surrounded by the *areola*[l], which, as well as the nipple, is remarkable for the colour[m] of the reticulum under the cuticle[n], and contains sebaceous follicles.[o]

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[f] "A. B. Kölpin, *De structura mammarum.* Griphisw. 1765. 4to.

Athan. Joannidis, *Physiologiæ mammarum muliebrium specimen.* Hal. 1801. 4to."

[g] "*v.* C. A. Covolo's two plates at the end of Santorini's posthumous tables."

[h] "*v.* Mich. Girardi, tab. i. annexed to the same plates of Santorini."

[i] "J. Gottl. Walter, *Observ. Anat.* p. 33. sq."

[k] "Santorini, tab. posth. viii."

[l] "Ruysch, *Thes.* i. tab. iv. fig. 4."

[m] "In pregnant women, especially during the first pregnancy, the nipples are usually yellow.

In the Samojede females, even when virgins, Klingstaedt asserts that they are quite black. *Mém. sur les Samojedes et les Lappons,* p. 44."

[n] "B. S. Albinus, *Annotat. Acad.* L. iii. tab. iv. fig. 3."

[o] "Morgagni, *Advers. Anat.* i. tab. iv. fig. 2."

"The secretion of the breast is the *milk*, well known in colour, watery, somewhat fatty, rather sweet, bland, resembling in all respects the milk of domestic animals, but subject to infinitely greater varieties in the proportion of its constituent parts, far more difficult of coagulation from the great quantity of essential salt, to be spoken of presently, which it contains, and affording no trace of volatile alkali.[p]

"When coagulated by means of alcohol, it presents the same elements as the milk of other animals. Besides the *aqueous* halitus which it gives off when fresh and warm, the *serum*, separating from the *caseous* part, contains sugar of milk[q] and acetic acid mixed with phosphate of lime and of magnesia, and with oil and mucus. The butyraceous *cream* is said to consist of globules of various and inconstant size, their diameter ranging between $\frac{1}{200}$ and $\frac{1}{600}$ of a line.[r]"

The lower portion of cow's milk which had stood some days was found by Berzelius[s] to have a specific gravity of 1·033, and to contain —

Water - - - -	928·75
Cheese with a trace of butter - -	28·00
Sugar of milk - - -	35·00
Muriate of potash - - -	1·70
Phosphate of potash - - -	0·25
Lactic acid, acetate of potash, with a trace of lactate of iron - -	6·00
Early phosphates - - -	0·30
	1000·00

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[p] "Fl. J. Voltelen (Præs. Hahn), *De lacte humano observationes chemicæ.* LB. 1775. 4to.

Parmentier and Deyeux, *Précis d'Expériences et Observations sur les différentes Espèces du Lait.* Strasburg, 1798. 8vo.

Thenard, *Annales de Chimie*, t. lix. p. 262."

[q] "Marc. L. Williamoz, *De sale lactis essentiali.* LB. 1756. 4to."

[r] "Senac, *Tr. du Cœur*, vol. ii. p. 276. ed. 2.

Fr. v. P. Gruithuisen, *Untersuch. über den Unterschied zwischen Eiter und Schleim durch das Microscop.* Munich. 1809. 4to. p. 16. fig. 15."

[s] *Medico-Chirurgical Transactions*, vol. iii.

The supernatant cream contained —

Butter	4·5
Cheese	3·5
Whey	92·0
	100·0[t]

Woman's milk is not quite so heavy, nor indeed so heavy as milk usually obtained from other animals for domestic purposes, as that of the goat, ass, mare, or even the sheep.

Milk is thus a compound of the three great nutrient principles, the saccharine, oily, and albuminous. See *suprà,* p. 65. sqq.

"The analogy between chyle and blood, and between both these fluids and milk[u], renders it probable that the milk is a kind of chyle reproduced, or rather again separated from the blood before its complete assimilation. This idea is strengthened by the frequent existence in the milk of the particular qualities of food previously taken[x], and by the chylous appearance of the watery milk secreted during pregnancy and immediately after labour.[y]

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[t] We have seen the analogy between vegetables and animals in structure and function, as well as in elementary and proximate principles. The secretions of both may be innocuous or deleterious. The most remarkable analogy in secretion respects milk. In South America, Humboldt saw a tree that, if wounded, yields abundance of rich milk, which the negroes drink and grow fat upon, and which affords a caseous coagulum. The tree grows on the barren rock; has coriaceous dry leaves; for several months is not moistened by a shower, and its branches appear dry and dead: yet, if an incision is made in its trunk, the milk pours forth. This "sweet vegetable fountain" is most copious at sunrise, and the blacks and natives are then seen hastening from all quarters with bowls to the *cow-tree.*

[u] "Consult J. Theod. Van de Kasteele, *Diss. de analogia inter lac et sanguinem.* LB. 1780. 4to.

And Alex. Wilson on the analogy between milk and chyle, *Observations relative to the Influence of the Climate,* p. 97. sqq."

[x] "*v.* Among a host of witnesses, Kölpin in Pallas's *Neuen nordischen Beyträgen,* vol. ii. p. 343."

[y] "Many circumstances induce me to believe that the lymph of the absorbents is of much importance in the secretion of milk.

For instance, the swelling of the subaxillary glands almost always observable during the first months of pregnancy.

"The reason why this bland nourishment of the fœtus becomes more thick and rich by continued suckling, is probably the abundance of lymphatics in the breasts. Those vessels continually absorb more of the serous part of the milk, in proportion as its secretion is more copious and of longer standing, and, by again pouring this part into the mass of blood, promote the secretion: after weaning they take up the remaining milk and mix it with the blood.

"The milk" is often secreted towards the end of pregnancy, and generally during labour, but "is secreted in greatest quantity immediately after delivery; and, if the infant sucks, amounts to one or two pounds every twenty-four hours, until the menses, which usually cease during suckling, return."

It at first contains a great deal of water and oil, and is called *colostrum*, and does not acquire its characteristic qualities before the third or fourth day.[z] After the abundant secretion of the first moment is passed, its quantity gradually increases up to 2 lb. or more daily till the eighth month, and then diminishes and contains less butter, cheese, and sugar.

"Occasionally virgins, and new-born infants of either sex, nay even men[a], as well as the adult males of other mammalia[b], have been known to furnish milk.

But especially the remarkable fact—that, in advanced pregnancy, when, from the womb compressing by its size the large and numerous lumbar plexuses of lymphatics, the legs have swollen, this œdematous tumour so completely disappears immediately after labour that the calves of the legs almost hang flaccid from the lymph finding no impediment in the lumbar plexuses and rushing upwards, and a copious secretion of milk instantly ensues upon the passage of the lymph.

The momentary thirst experienced on applying the child to the breast, from the absorption of fluid in the fauces, may be also mentioned."

[z] The larger the animal, the longer generally is its period of suckling; and the greater its fecundity, the shorter. The first milk is as imperfect in the cow as in woman.

[a] "This is asserted to be common in Russia. *Comment. Acad. Sc. Petropolit.* vol. iii. p. 278. sq."

Mr. Wentzel met with an old Chipewyan, who, on losing his wife in child-

[b] "I have spoken of this at large in the *Hannoverish. Magazin*, 1787, p. 753. sqq."

"The abundance of milk excites its *excretion*, and even causes it to flow spontaneously: but pressure, or the suction of the

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birth, had put the infant to his breast, and earnestly prayed that milk might flow, and had actually been happy enough to see sufficient produced to enable him to rear the child. The Indian was now old, but the left breast still retained the unusual size acquired by nursing. (Captain Franklin's *Narrative of a Journey to the Polar Sea*, p. 157. sq.)

A parallel instance is recorded by a Bishop of Cork. His lordship had given half-a-crown to a poor Frenchman above seventy years of age, who made the best return he could by showing his lordship what he knew must be a curiosity, — two very large breasts, with nipples larger than the bishop had ever seen in a woman; and related that, his wife dying when his child was two months old, he endeavoured to pacify it at night by putting it to his breast, and at length milk actually came, so that he suckled and brought it up. (*Phil. Trans.* vol. xli. p. 813.)

A lamb, belonging to Sir William Lowther, having lost its mother, sucked a wether "and brought him to milk and was maintained by him all the summer: he had two considerable teats on his udder, each side whereof was about the bigness of a hen's egg," and the milk was made to spurt to a distance of two yards a month after the lamb was weaned. (*Phil. Trans.* No. 214. p. 263.)

Blumenbach has described a he-goat which it was necessary to milk every other day for a year (*Hannoverisch. Magazin*, 1787, p. 753. *Comparat. Anat.* § 364.); so that, to say with Virgil, *mulgeat hircos*, is not tantamount to calling a man a fool.

A bull which had been put to cows successfully, but had also female organs, though the vagina was apparently too small to have ever admitted the male organ, gave milk, according to satisfactory testimony. (*Phil. Trans.* 1799, p. 171. sq. See *suprà*, p. 712. n. a.)

I myself saw two married women with milk in their breasts, one of whom had never been pregnant, but always menstruated regularly and said this had been the case for nine months; the other had not been pregnant for upwards of six years, had weaned her child, and at the end of seven months miscarried, and said she had immediately afterwards observed the milk, which had been secreted for six months and was increasing at the time I saw her.

I also attended a young single lady, whom I believe never to have been pregnant, but who was subject to amenorrhœa, and had then not menstruated for five months, and laboured, apparently, under ovarian disease: milk oozed very copiously from her breasts, and the medical attendant informed me that the left had secreted it for many months.

In the *Phil. Trans.* abridged, vol. ix. p. 206. sq. is an instance seen by Dr. Stack, in Tottenham Court Road, of an old woman of sixty-four, who had not borne a child for sixteen years, secreting milk after repeatedly applying her grandchild to her breasts for the purpose of quieting it, and continuing to furnish child, completes its discharge." The erection of the nipple causes the ducts to become straight and thus allow the free discharge of the milk.

Women often find the secretion of milk suddenly augmented after taking liquid nourishment. Even during the refreshment they may experience a secretion of fluid rushing into their breasts, and the breasts may swell, and even milk may ooze from them. The circumstance of sucking not only augments at the time the quantity secreted, but keeps up the disposition to secrete. Above 20 pints may be got from a cow at one milking,—a quantity far beyond what the breast will contain: two children may suck and find sufficient milk, and if the child is withdraw the secretion ceases. When the child is put to the breast, the mother may soon find the sensation of a rush of fluid to the organ.

It is asserted that the quantity of cream and quality of the milk varies during the process of milking, in the case at least of cows, asses, and goats. By milking cows into different cups, the excess of cream in the last over that of the first was generally sixteen to one, and the average ten or twelve to one. The cream of the milk first drawn was thin and pale; that of the last thick and buttery, and of a rich colour. The milk too of the first cup was blue and like milk and water; that of the last rich, and to the eye and taste more like cream.[c] We know that the quantity and quality of the fibrin of the blood received into different cups varies during venesection.[d]

The secretion is greatly influenced by moral circumstances. A mother often finds a temporary decline of secretion if she substitutes another child for her own or for one that she had previously suckled for some time. A cow may give less milk when milked by a stranger. If a mother sees her child, or even thinks of it,

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milk in great abundance up to the time of the narration,—four years, to the children of her daughter, who, finding her mother so useful, "was emboldened to bid fair for an increase of issue, which, till then, she knew not how to nourish or provide for." Many other such cases may be found. See Beck's *Elements of Medical Jurisprudence*, fifth ed. London, 1836, p. 121. sq.

One woman is said to have suckled from the age of 25 to her 72d, and now in her 81st year still to have a regular secretion. The case is recorded by Dr. Kennedy in Dr. J. Johnson's *Medico-Chirurgical Review*, vol. xxi. p. 202.

[c] Blacker's *Essay on Small Farms*.

[d] Scudamore, *Essay on the Blood*, p. 97. London, 1824.

she may feel her breasts filling.[e] After emotion of the mother, the child, if it suck the milk first secreted subsequently, may suffer seriously in its health.[f]

Like every other secretion it is greatly influenced not only in quantity and quality by all emotions, but by the condition of the system at large and of other individual organs. If the mother is in health and well fed, it will be rich and abundant; and *vice versâ*. If she is ill, it will be of bad quality and small in quantity. If peculiar substances are swallowed it becomes impregnated with them, as purgatives, mercury, &c.

Cerebral character and corporeal circumstances have appeared sometimes communicated by the milk.

The milk of a particular female will sometimes not suit a particular child.

The mode of nourishment after birth is various. Some young are able, without any peculiar arrangement, immediately to support themselves; for the delivery of each species of brutes is ordained at that season of the year when every thing is in the most favourable state for administering to the necessities of the offspring. Most invertebrata and some fish deposit their eggs where food can be easily procured. Some, many insects for example, are born in the midst of food, the parent having instinctively deposited the egg in nutrient matter either found in mass or carefully collected by her.* The young of some devour their nest immediately, just as some insects eat up their skin when they have cast it off. Others have food collected daily by one or both parents, who, while they fatten their young, perhaps grow thin themselves by neglect. The raw food given by birds to their young is always animal, and therefore easy of assimilation. Some give their young half digested food, thrown up from their own stomach. Some, as all the dove kind, are fed by a substance secreted from the crops of both parents; (Hunter, *On a secretion in the crops of breeding pigeons for the nourishment of their young*, in his *Observations on certain parts, &c.* p. 235.;) others by a fluid secreted by peculiar glands belonging to the female only. The instinct which leads the parent carefully to tend the offspring ceases at the period when the system of the offspring is sufficiently advanced to supply its own exigencies; and the parent does not breed again till this is the case.

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[e] John Hunter satisfied himself experimentally of the truth of the common assertion,— that the she-ass gives milk no longer than the impression of the foal is upon her mind. The skin of her foal thrown over the back of another, and frequently brought near her, is sufficient. (*Journal of the Royal Institution*, No. 2.)

This opinion coincides with the custom in Languedoc and on Mount Caucasus, of placing a calf near its mother while milking, from the conviction of its increasing the quantity of milk. According to Le Vaillant, at the Cape of Good Hope, if the calf dies, its skin is placed on another while the cow is milking.

[f] Mr. Wardrop had removed a small tumour from behind the ear; all was doing well, till the mother fell into a violent passion, and suckled her child soon afterwards, when immediately it died in convulsions. He was sent for hastily to see another child in convulsions, after taking the breast soon after its nurse had been severely reprimanded: and Sir Richard Croft, the accoucheur who had charge of the patient, informed Mr. Wardrop that he had seen very similar instances. (*Lancet*, No. 516.)

Dr. Hayn declares that he was summoned to a child which had just died in the act of sucking its mother, when she was suddenly alarmed at the entrance of a policeman with bad news, soon after delivery. Dr. Berlyn mentions an infant, three months old, seized with deadly paleness, hemiplegia of the left side and convulsions of the right, on sucking immediately after its mother had met with some distressing circumstance. A puppy has been seized with epilepsy on sucking its mother after a fit of rage. (Burdach, § 522.)

Such are the degrees of assistance afforded by the parent.

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* Some insects,—ichneumons, lay their eggs in living caterpillars or other species of their own genus, which are consequently destroyed, so that certain species appear to naturalists created solely for the destruction of others. A most cruel example is the female of a species of sphex; she digs a hole in sandy ground, drags a large spider or caterpillar into the hole, bites off its legs to prevent its escape, and deposits an egg in the hole, so that the young one may nourish itself with the spinning fluid of the poor animal. (Blumenbach, *Handbuch der naturgeschichte.*)

CHAP. XXXV.

OF THE DIFFERENCES IN THE SYSTEM BEFORE AND AFTER BIRTH.[a]

"From what has been said relatively to the functions of the fœtus still contained within its mother, and immersed as it were in a warm bath, there must evidently be a considerable difference between its functions and those of the child that is born and capable of exerting its will. The chief points of difference we will distinctly enumerate.

"To begin with the blood and its motion, this fluid is remarkable both for being of a darker red, incapable of becoming florid on the contact of atmospheric air, and for coagulating less readily and perfectly than after birth.[b] Its course, too, is very different in the fœtus whose circulation is connected with the placenta and which has never breathed, from its course after the cessation of this connection with the mother and after respiration has taken place.[c]

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[a] "On the subject of this chapter consult, among numerous others, Trew, *De differ. quibusdam inter hominem natum et nascendum intercedentibus.* Norimb. 1736. 4to.

Andr. and Fr. Koesslein (brothers), *De differentiis inter fœtum et adultum.* Ibid. 1783. 4to.

Ferd. G. Danz, *Zergliederungskunde des ungebohrnen Kindes mit Anmerk.* von S. Th. Soemmerring. Frankfort, 1792. 2 vols. 8vo.

Also Theod. Hoogeveen, *De fœtus humani morbis.* LB. 1784. 8vo. p. 28. sq.

Fr. Aug. Walter, *Annotat. Academ.* already quoted, p. 44. sq.

And J. Dan Herholdt, *De vita imprimis fœtus humani.* Havn. 1802. 8vo. p. 61. sq."

[b] "Fourcroy, *Annales de Chimie*, t. vii. p. 162. sq."

[c] "Consult Herm. Bernard, *De eo quo differt circuitus sanguinis fœtus ab illo hominis nati.* Reprinted in Overkamp's collection, t. i.

Jos. Wenc. Czikanek, *De actuosa hominis nascituri vita s. circulat. fœtus ab hominis nati diversitate.* Reprinted in Wasserberg's collection, t. iv.

Sabatier, at the end of his *Tr. Complèt d'Anat.* vol. iii. p. 386. sq. 1781.; and in the *Mémoires Mathemat. et Physiques de l'Institut,* t. iii. p. 337. sq.

" First, the umbilical vein, coming from the placenta and penetrating the ring called umbilical, runs to the liver, and pours its blood into the sinus of the vena portæ, the branches of which remarkable vein distribute one portion through the liver, while the *ductus venosus* ARANTII[d] conveys the rest directly to the inferior vena cava.

" Both canals, — the end of the umbilical vein contained in the abdomen of the fœtus and the venous duct, become closed after the division of the chord, and the former is converted into the round ligament of the liver.

" The blood, arriving at the right side of the heart from the inferior cava, is in a great measure prevented from passing through the lungs, and is divided into the left or posterior auricle of the heart, by means of the Eustachian valve, and the foramen ovale.

" For, in the fœtus, over the opening of the inferior cava, there is extended a remarkable lunated *valve*[e], termed, from its discoverer[f], Eustachian, which usually disappears as adolescence proceeds, but, in the fœtus, appears to direct[g] the stream of blood coming from the abdomen towards an opening, immediately to be mentioned, existing in the septum of the auricles.

" This opening is denominated the *foramen ovale*[h], and is the cause that certainly the greatest part of the blood which streams from the inferior cava is poured into the left auricle[i] during the diastole of the auricles. A falciform valve, placed over the foramen, prevents its return, and appears likewise to preclude its

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But especially J. Fr. Lobstein, *Magazin Encyclopédique.* 1803. t. iii. vol. li. p. 28. sq."

[d] " *v.* Arantius, *De humano fœtu libellus,* p. 97.

Compare B. S. Albinus, *Explicatio tabular. Eustachii,* p. 164. sq."

[e] " Haller, *De valvula Eustachii.* Gotting. 1738. 4to."

[f] " Eustachius, *De vena sine pari,* p. 289. Opuscula, tab. viii. fig. 6. tab. xvi. fig. 3."

[g] " J. F. Lobstein, *De valvula Eustachii.* Arg. 1771. 4to."

[h] " Haller, *De foramine ovali et Eustachii valvula.* Gotting. 1748. fol. c. f. ae. and much more copiously in his *Opera minora,* t. i. p. 33. sqq."

[i] For an account of the opinion of C. Fr. Wolff, who regards the foramen ovale as another mouth of the inferior cava, opening into the left auricle in the same manner as the mouth commonly known opens into the right, see *Nov. Comment. Acad. Scient. Petropol.* t. xx. 1775."

course into the right auricle during the systole of the auricles. By means of this valve, the foramen generally becomes closed in the first years of infancy, in proportion as the corresponding Eustachian valve decreases, and more or less completely disappears.[k]

" The blood which enters the right auricle and ventricle principally proceeds from the superior cava, and flows but in a very small quantity into the lungs, while, from the right ventricle, which, in the fœtus, is particularly thick and strong for this purpose, it pursues its course directly to the arch of the aorta, by means of the *ductus arteriosus*[l], which is in a manner the chief branch of the pulmonary artery. A few weeks after birth, this duct becomes obstructed and converted into a kind of dense ligament.

" The blood of the aorta, being destined to return, in a great measure, to the mother, enters the *umbilical arteries*, which pass out on each side of the urachus at the umbilical opening, and, after birth, likewise become imperforate chords.[m]

" As the function of the *lungs* scarcely exists in the fœtus, their appearance is extremely different from what it is after the commencement of respiration. They are proportionally much smaller, their colour is darker, their substance denser, consequently their specific gravity is greater, so that while recent and sound they sink in water, whereas, after birth, they, cæteris paribus, swim upon its surface.[n]"

" From our remarks upon the nutrition of the fœtus, it is clear that its alimentary tube and chylo-poietic system must be peculiar. Thus, *v. c.* in an embryo a few months old, the *large intestines* very nearly resemble the small; but, during the latter half of pregnancy, being turgid with meconium, they really deserve the epithet by which they are commonly distinguished.

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[k] " H. Palm. Leveling, *De valvula Eustachii et foramina ovali.* Anglipol. 1780. 8vo. c. f. ae."

[l] " B. S. Albinus, *Annot. Acad.* l. ii. tab. vii. fig. 7."

[m] " *v.* Haller, *Icones Anat.* fasc. iv. tab. iii. vi."

[n] " This is not the proper place for explaining the conditions under which this occurs, and the cautions therefore requisite in giving an opinion, in a court of justice, founded on the *examination* of the *lungs*. Among many other writings, the very important posthumous paper of Wm. Hunter may be consulted in the *Medical Observ. and Enquiries*, vol. vi. p. 284. sq.

Ph. Corn. Heineken's dissertation, *De docimasia pulmonum incerto vitæ et mortis recens natorum signo.* Gott. 1811. 4to.

And Fr. B. Osiander, *Comment. de respiratione, vagitu et vi vitali fœtus humani inter partum &c.*, on which compare the *Götting. Gel. Ang.* 1820, p. 1955. sq."

" The *meconium* is a saburra, of a brownish green colour, formed evidently from the secreted fluids of the fœtus, and chiefly from its bile, because it is first observed at the period corresponding to the first secretion of the bile, and, in monstrous cases, where the the liver has been absent, no meconium, but merely a small quantity of colourless albumen and mucus, has been found in the intestines," which from the absence of bile have not been stimulated to secrete abundantly. The meconium has the same taste and colour and affords the same products as cystic bile.

" The *cæcum* is extremely different in the new-born child from its future form, and continued straight from the appendix vermiformis, &c.[o]

" Other differences we have already spoken of, and shall now pass over. Such are the *urachus*, the *membrana pupillaris*, and the *descent of the testes* in the male. Some will be treated of more properly in the next section. Others, of little moment, we shall entirely omit."

One of the most striking peculiarities of the fœtus is the very great proportionate bulk of its liver. The prodigious size of this organ arises from the distribution of four fifths of the blood of the umbilical vein through it, and probably, in a certain degree, as some think, from the great quantity of meconium in its biliary ducts. After birth, no blood is conveyed by the umbilical vein, and the expansion of the thorax readily expresses the abundance of meconium; hence the liver must diminish.

This peculiarity, as well as the great size of the thyreoid, thymus, and supra-renal glands — parts presently to be described, probably serves to produce certain necessary changes in the blood; but an evident good effect results from it in relation to the organs of the thorax. In the fœtus the lungs are completely devoid of air, and consequently there cannot be much, if any, circulation of blood through the pulmonary artery and veins, and the liver, by its magnitude, protruding the diaphragm upwards, renders the capacity of the chest correspondently small, and at the same time it contains an immense proportion of blood. After birth, the diminished size of the liver allows a great increase to the capacity of the chest; not only is full inspiration allowed, and consequently a free passage to the blood of the pulmonary vessels during inspiration, as Haller remarks [p], but a certain degree of permanent dilatation of the lungs is allowed (for much air remains in the lungs after every expiration), and, since the liver contains, immediately after birth, so much smaller a portion of the blood of the system than before, the greatly increased supply required by the lungs is thus afforded.[q]

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[o] " B. S. Albinus, *Annotat. Acad.* l. vi. tab. ii. fig. 7."

"This is a favourable opportunity for briefly noticing some remarkable parts which are out of all proportion larger in the fœtus, and appear to serve important purposes in its economy, although their true and principal design deserves still further investigation.

"They are usually styled glands, but their parenchyma is very different from true glandular structure, nor has any vestige of an excretory duct been hitherto discovered in them. They are the thyreoid, the thymus, and the supra-renal glands.[r]

"The *thyreoid gland* [s] is fixed upon the cartilage of the same name belonging to the larynx, has two lobes," united by an isthmus which lies across the third and fourth ring of the trachea, is composed of lobules irregular in shape and size, and "is, as it were, lunated[t], and full not only of blood, in which it abounds in the fœtus, but of lymphatic fluid, and becomes, as age advances, gradually less juicy.[u]

"The *thymus* is a white and very delicate structure," surrounded by cellular tissue that connects it with the adjoining parts and binds together its own numerous conglomerated lobules, which vary from the size of a pin's head to that of a pea, is "likewise bilobular, sometimes completely divided into two parts," "contains a remarkable cavity[x]," around which the lobules are disposed spirally like knots, and is "placed under the superior part of the middle of the sternum, always ascending as far as the neck on each side[y], of extremely great proportionate size in the fœtus, abounding in a milky fluid, becoming gradually absorbed in youth, and frequently disappearing altogether in old age.[z]" Every lobule contains several cells, all which open into a small pouch at the base of the lobule, and the pouches of all the lobules communicate with the central cavity.[a] Although there is no external opening, as in true glands, Sir Astley Cooper finds absorbent vessels in the fœtal calf so large as to admit a common injecting pipe and coarse injection, and opening into the veins at the lower part of the neck.

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[p] *Elementa Physiologiæ*, t. viii.

[q] See Mr. Bryce, *Edinb. Med. and Surg. Journal.* 1815. Jan.

[r] "F. Meckel, *Abhandlungen aus der menschilchen und vergleichenden Anatomie.* Halle, 1806. 8vo. He makes it probable that these three organs contribute to the chemical functions of the nervous and hepatic systems, and thus diminish the quantity of hydrogen and carbon."

[s] "C. Uttini, *De glandulæ thyroideæ usu*, in the *Comment. Instituti Bononiens.* vol. vii. p. 15. sq."

[t] "Haller, *Icones Anat.* fasc. iii. tab. 3."

[u] "J. Ant. Schmidtmüller, *Ueber die Ausfuhrungsgange der Schilddrüse.* Landshut. 1804. 8vo."

"The *supra-renal glands*, called also renes succenturiati and capsulæ atrabiliariæ, lie under the diaphragm on the upper margin of the kidneys[b], from which, in the adult, they are rather more distant, being proportionally smaller. They" have a triangular close cavity in their centre, "full of a dark fluid of a more reddish hue in the fœtus than in the adult." In early fœtal life, they are granular, and absolutely larger than the kidneys; which, however, towards the end of gestation, greatly surpass them. Their secretion is probably conveyed to the blood by the absorbents like that of the thymus.

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[x] "Aug. Louis de Hugo, *De glandulis in genere et speciatim de thymo.* Gotting. 1746. 4to. fig. 2.

Morand the younger, *Mémoires de l'Acad. des Sc. de Paris,* 1759, tab. 22—24.

Vincent Malacarne, *Memorie della Società Italiana,* t. viii. 1799, P. i. p. 239. sq.

Flor. Caldani, *Congettura sopra l'uso della glandula timo.* Venice, 1808. 4to.

Sam. Chr. Lucae, *Anatomische Untersuchungen der Thymus,* fasc. i. ii. Frankfort on the Maine. 1811. 4to.

C. Fr. Th. Krause, *Opinionum de thymi functione examen.* Gott. 1818. 8vo."

[y] "Haller, *Icones Anat.* l. c."

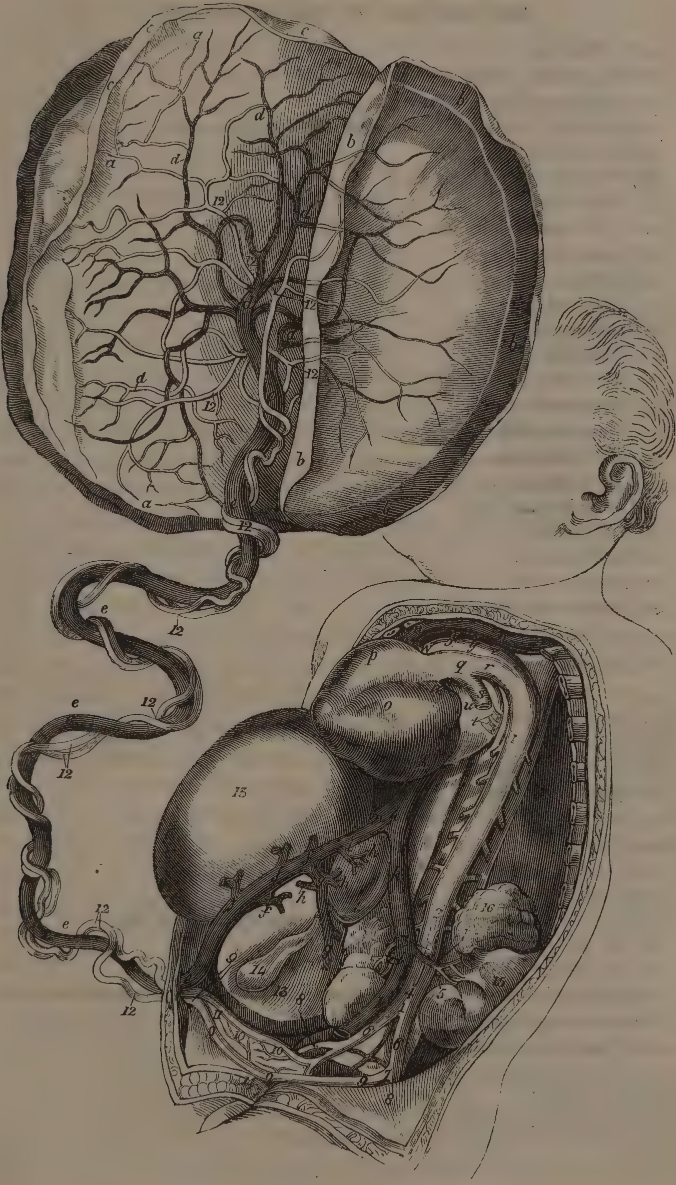
[z] "Hewson, *Experimental Enquiries,* P. iii. passim."

[a] *The Anatomy of the Thymus Gland,* by Sir Astley Cooper, Bt. London, 1832.

[b] "See Eustachius their discoverer, tab. i. ii. iii., and tab. xii. fig. 1. 10. 12.

Haller, *Icones Anat.* fasc. iii. tab. vi.

Malacarne, l. c."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DESCRIPTION OF FOREGOING CUT.

a a a, Placenta.
b b b b b, Portion of the amnion covering it.
c c c, Portion of the chorion.
d d d d d d d, Veins of the placenta uniting into one trunk.
e e e e e e, Umbilical vein.
f f f, Its branches entering the liver.
g g, Vena portæ.
h h h, Its hepatic branches.
i, Ductus venosus.
k k k, Inferior cava.
l l, Renal veins.
m, Hepatic vein.
n n, Superior cava.
o, Heart turned to the right.
p, Right ventricle.
q, Pulmonary artery.
r, Canalis arteriosus.
s, Left pulmonary artery divided.
t, Left pulmonary veins.
u, Left auricle.
v, Left ventricle.
w, Aorta.
x, Brachio-cephalic trunk.
y y y, Left carotid.
z, Left subclavian.

1, Descending aorta.
2, Cœliac artery divided.
3, Superior mesenteric.
4, Inferior mesenteric.
5, Left renal.
6 6, Iliacs.
7 7, Hypogastrics.
8 8, Femorals.
9 9 9 9, The umbilical arteries going towards the umbilical ring.
10 10, Their branches going to the bladder.
11, Urachus.
12 12 12 12 12 12 12 12, Umbilical arteries, running in a serpentine course towards the bladder.
13, The liver reversed.
14, Gall bladder.
15 15, Kidneys.
16 16, Renal capsules.

CHAP. XXXVI.

THE ORIGIN, GROWTH, DECLINE, AND DEATH OF THE HUMAN SYSTEM.

The origin of every living being is some matter of such a composition that it has the property of changing, under certain circumstances, in its composition and therefore its properties, and becoming organised; and, when so changed, of again changing in composition, organisation, and properties; and this in unceasing succession, till a being is completed of definite form and power, and perhaps composed of numerous organs, each peculiar in its composition, organisation, and properties. Whether the first matter so compounded by the coincidence of certain elementary particles under certain circumtsances be inanimate or dead,—a possibility admitted by the believers in heterogenesis, or furnished alive by a living system from itself, it has not the composition nor parts, and, therefore, not the properties, which subsequently exist. It has the property merely of changing to some new composition — of acquiring organisation, form, and new properties, under certain favourable circumstances; and, when so altered, the altered thing has the property of changing in like manner, and thus, at last, an organ, or a system of organs, is produced. When the changes have arrived at a certain point, the characteristic properties of the organ result, not full and perfect at first, but faint; and gradually, as the composition and organisation improve, they become more intense. Thus the liver does not secrete bile when its rudiments are first discernible, but at length it does. Yet at first the bile is poor, and only becomes perfect when the organ is perfect. At first there can be no consciousness and personality in the brain; but, as its composition and organisation proceed, glimmerings of these must appear, and at length both these and volition exist, and, as each part improves in composition and bulk, faculty after faculty appears and grows stronger. The original property results from a certain composition of certain elementary substances placed under certain circumstances: other properties result from changes in the composition and from the production of organisation, — from another composition and from organisation; and, as these change successively, each new composition and organisation[a] is necessarily possessed of peculiar properties while placed in certain circumstances. Thus a little fluid (for all organised bodies are produced from fluids) in the ovaria becomes a vesicle; this, a little organised something—though, perhaps the vesicle must be considered an organisation; this, by degrees, the various parts of a human being successively, till a human being can be recognised; and all its parts grow and change till we have a man. In all living organisations, the composition, structure, size, and the number of organs differ at different times; none is at first what it is afterwards. All continue changing in volume, consistence, form, texture, situation, mode of action; and, while one organ developes, another disappears.[b] These properties or powers are the result of a certain composition, and often also organisation, placed in certain circumstances: but this composition and organisation are the result of previous composition, and perhaps also organisation, and circumstances; and so we can go back, step by step, till we arrive at the original composition and circumstances. The mind is a property or power resulting of necessity from the composition and organisation of the brain under certain circumstances: but this composition and organisation of the brain result from a succession of changes, each resulting from an immediately preceding state of composition, and, except the commencement of organisation, of organisation also, in which previous state there was, from its nature, necessarily the property of changing to the subsequent.[c]

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[a] Some object to the employment of the word organisation in the signification of an organised system, alleging that it never means the thing organised, but always the process of organising, and they therefore employ the term organism in that sense. Dr. Barclay, in his *Inquiry into Opinions concerning Life and Organisation*, — a book worth reading as a compilation only of the curious opinions of successive times, but full of dull error and prejudices, — says, "Organisation is a general expression for the process by which an organised structure is formed, and, therefore, can never properly denote the possession of organs." P. 340.

Now, the use of the word organisation to signify the thing organised, is not only established, but supported by all analogy. Just as we employ the term in two senses,— that of the thing organised and that of the process of organisation, other words are used for acts and results. The chemist, the musician, and the rest of the world, use the term composition in the two senses of compounding, composing, and of the thing compounded or composed; the anatomist, pharmaceutist, and the rest of the world, employ the term preparation to signify the act of preparing, and the thing prepared; and the same twofold use is made of the words combination, declaration, exhibition, generation, puncture, painting, reflection, and endless others, with general sanction.

A similar habit prevails of restricting the word animal to the brute creation; so that some say man and animals, while others say man and other animals. The Latin word animal is used in both ways correctly. But, to avoid confusion, it is much better to have a rule, and, as we have a term always applied exclusively to other animals, the term animal throughout this work includes man. Whenever I have wished to speak of other animals, I have employed the term *brute*, — and written brute creation, brute animals, or brutes, in conformity with the established use of this English word. I have already quoted Milton's lines, —

"Smiles from reason flow,
To *brute* denied."

Again, —

"What may this mean? Language of man pronounced
By tongue of *brute*, and human sense expressed."

Locke, in his *Essay on the Human Understanding*, says, "*Brutes* may be considered as either aërial, terrestrial, aquatic, or amphibious." Pope, in his *Essay on Man*, has the celebrated lines, —

"Heaven from all creatures hides the book of fate,
All but the page prescribed, their present state;
From *brutes* what men, from men what spirits know,
Or who could suffer being here below."

[b] Burdach, § 477.

[c] See notes, p. 363. *suprà.*

" Some physiologists of reputation have contented themselves with roundly asserting that true generation never occurs, but that the whole human race pre-existed in the genitals of our first parents, in the shape of previously formed germs which become evolved in succession.

Some of these imagined the germs to be the spermatic animalcules of the male (see W. Fr. v. Gleichen, l. c.); others imagined them to exist in the ovaries of the mother. *

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* " *v. c.* The illustrious Haller, who plainly asserted, *that all the viscera and even the bones of the future fœtus, nearly fluid indeed and therefore invisible, were pre-formed, before conception, in the maternal germ.*

In support of this hypothesis, he argued chiefly from the continuity of the membranes and blood-vessels between the incubated chick and the yelk of the egg. (*Opera Minora*, t. ii. p. 418. sq.)

But the more frequently I have demonstrated the phenomena of incubation in my physiological class, the less strength have I found in this argument.

We saw, in Chapter XXVIII., the various modes in which a new being is produced from one already existing;—that it may be a de-

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This hypothesis of the successive evolution of germs pre-formed from the creation, must, if carefully examined, be rejected. (" See L. P. *Zweifel gegen die Entwickelungstheorie. — Aus der Französischen Handschrift von* G. Forster. Gotting. 1788. 8vo." See also C. F. Wolff, *Theoria Generationis,* Berlin, 1759, who opposed it successfully.)

Not only is the superfluous and useless creation, which is supposed, of innumerable germs never arriving at evolution, repugnant to reason *, but so many preternatural conditions † and such a multiplication of natural powers ‡ are assumed, that it is perfectly irreconcileable with sound physiology.

Add to this, that, of the phenomena adduced in its favour, no one is sufficiently consonant with truth to establish the hypothesis. §

On the other hand, we have indubitable observations which refute it directly and completely."

" Such, in the history of *hybrid* animals, is the singular experiment of impregnating those which are *prolific,* for many generations, with male semen of the same species, by means of which the form of the young hybrids becomes so progressively different from the original maternal configuration, as to approach more and more to that of the father, till, by a kind of arbitrary metamorphosis, it is absolutely converted into it. (Jos. G. Kölreuter, *Dritte Forsetzung der vorläuf. Nachr.* p. 51. sq.)

Such, in our knowledge of *monsters* (which, according to the hypothesis of evolution, are nearly all maintained to have pre-existed in the germs from the

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Nor can I sufficiently wonder how this great physiologist could so constantly reject, as almost absurd, the inosculation, properly so called, of the vessels of the chick with those of the yelk, while at the same time he admitted and defended a perfectly similar inosculation in the connection of the human ovum with the gravid uterus!

See his *Elem. Physiol.* Lausannæ, 1788. t. viii. P. i. p. 94. comparing p. 257."

* Indeed, in this strange hypothesis there must have been an uncommon store of germs prepared at the beginning, for the ovaria of a single sturgeon have contained 1,467,500 ova. (Petit, *Mém. de l'Acad. des Sciences,* 1733.)

The fancy of the existence of all the human race, inclosed like pill-boxes—*emboitement,* in our hapless general mother, is as unfounded in fact as it is preposterous.

† " *v.* Kant's remarks on these, *Critik der Urtheilskraft,* p. 372."

‡ " This defect I have shown at large, *Handbuch der Naturgeschichte,* p. 14. sq. 10th edit."

§ " Those who desire a fuller demonstration of this and other assertions but briefly noticed in the present section, I refer to the work, *Ueber den Bildungstrieb.* 3d edit. Gotting. 1791. 8vo."

tachment of a larger or smaller portion of the old, which afterwards grows forth into another perfect system (fissiparous generation);

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first creation), is the well-known fact — that among certain *domestic* species of animals, and especially among sows, monstrosities are very common, whereas in the original wild variety they are extremely uncommon.

While the phenomena of *reproduction* are all much more explicable by the nisus formativus than by the pre-existence of germs for every part, some particular instances (*v. c.* that of the nails, which, after the loss of the first phalanx of the fingers, have been known to be reproduced on the neighbouring middle phalanx *), admit evidently of no other solution."

" The less this hypothesis of evolution, as it is commonly termed, is found consonant with fact and the rules of philosophising, the more strongly does the opposite opinion recommend itself to our notice by its simplicity and correspondence with nature, supposing as it does, not an evolution of fictitious germina by conception, but a true generation and gradual formation of a new conception from the hitherto formless genital matter.

This true generation by successive formation has been variously described by physiologists, but the following we consider as the true account.

1. The *matter* of which organised bodies, and therefore the human frame, are composed, differs from all other matter in this, — that it only is subject to the influence of the vital powers. (See Chr. Girtanner, *Ueber das Kantische Prinzip für die Naturgeschichte.* Gotting. 1796. 8vo. p. 14. sq.)

2. Among the orders of vital powers, one is eminently remarkable and the least disputable of all, which, while it acts upon that matter, hitherto shapeless but mature, imparts to it a *form* regular and definite, although varying according to the particular nature of the matter.

To *distinguish* this vital power from the rest, permit us to designate it — NISUS FORMATIVUS.

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* " Recent instances of this remarkable phenomenon are related by Corvisart, *Journal de Méd.* March, 1809.

N. Ansiaux, *Clinique Chirurgicale.* Lyons, 1816. 8vo. p. 217.

London Medical and Physical Journal, July, 1816.

Another example I owe to my friend F. Sig. Voigt, professor at Jena.

But the most remarkable case I myself saw in a young medical man, attending my lectures, who, when with the French army, lost the last joints of three fingers of the left hand, and two joints of the little finger, by frost, in the famous retreat to Beresina. The following year horny rudiments of nails were reproduced on the last phalanx but one of the fore, middle, and ring finger, but the little finger remained as before."

See other examples at p. 249. sq. *suprà.*

The cut part of half a potatoe has been seen covered with little tubercles, similar to those on the convex surface, and from which fresh potatoes originate. (See Keratry, *Inductions Physiolog. et Morales.*)

that it may be the detachment of a peculiar part, prepared for the purpose, which first grows forth (gemmiparous and propagular generation); or that a peculiar substance is secreted and retained as a something distinct from the parent, and that this may be of the same common nature as the parent, or a vesiculiform mass termed an *ovum*.

An ovum is produced in a peculiar organ; but is not capable of growing into a perfect new being, unless a substance is supplied by another organ of either the same or a different being. In mammals the other organ is always in another being[d], and one

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3. The nisus formativus occurs to the genital *matter*, when this is mature and committed to the uterus in a proper condition and under proper circumstances, produces in it the rudiments of conception, and gradually *forms* organs fitted for particular purposes; preserves this structure during life, by nourishing the body; and reproduces, as far as it can, any part accidentally mutilated." *

[d] An accidental pregnancy was frequently attributed in former days to the warmth of imagination, the influence of demons, and many other circumstances supposed equally powerful as the deed of kind. In Venette's *Tableau de l'Amour conjugal*, and in Bartholin's works, may be seen an *Arrêt Notable de la Cour du Parlement de Grenoble*, which, upon the attestation of many *matrones* and *sages, femmes* and *docteurs* of the University of Montpellier, *et autres personnes de qualité*, that

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* "Here allow me to" remark.

"1. I have used the expression — nisus formativus, merely to *distinguish* it from the other orders of vital powers, and by no means to explain the *cause* of generation, which I consider equally involved in Cimmerian darkness as the cause of gravitation or attraction, which are merely terms given to effects known, like the nisus formativus, à posteriori.

2. The word NISUS I have adopted chiefly to express an energy truly vital, and therefore to distinguish it as clearly as possible from powers merely mechanical, by which some physiologists formerly endeavoured to explain generation."

Blumenbach has been charged with having introduced an imaginary agent, which he created for the purpose of executing this particular office and denominated the nisus formativus. (Dr. Bostock's *Elementary System.* 1836. p. 672.) Now he merely states a fact — that certain matter has the capability of acquiring certain composition, organisation, and properties and forms; and he calls this capability, nisus formativus, thus effectually excluding all hypothesis. He designates the fact of the formation and nutrition taking place not simply but for a final purpose, — to produce structures destined for certain ends, the union of a physico-mechanical principle with the teleological; and this Dr. Bostock considers a "radical error." It is merely a choice of words to express a fact.

application of the male fluid is sufficient for only one conception: but among poultry a hen will lay a long succession of fruitful eggs after one intercourse with the cock; and the nine generations of the aphis will come forth after one impregnation, — eight being entirely of females, and the ninth partly of males.

The fundamental materials of the germ supplied by the female undergo a certain number of changes independently of the male fluid. Besides the store of nourishment, the germinal vesicle and the macula germinativa on its internal surface are found in unimpregnated ova; and the vesicle is said to burst and unite with its enveloping coat into a membrane formed of both, and termed blastoderm or incipient germinal membrane in birds and some other vertebrata which are not mammals. Further approaches towards the existence of the embryo require the influence of the male fluid.

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women often fall pregnant spontaneously, declares a lady who had brought forth a son although her husband had been absent four years, to be a woman of worth and honour, and the child to be the legitimate heir of Monsieur the husband. When a demon bore the blame, he was called an *incubus*, and his semen always struck so cold to the ladies "*ut displicentiam magis quam delectationem inde sint consecutæ.*" (Zacchias, *Quæstiones Medicæ Legales*, lib. vii. tit. 1. Quest. vii. 7.) A demon that played the part of a female, was named a *succubus*. It was asserted that a mischievous devil would often act as a *succubus*, and then, metamorphosing himself into an *incubus*, deposit in the vagina of some woman the semen which he had received from a man.

As they believed that ladies could breed without gentlemen, so they believed that some gentlemen might be hermaphrodite and breed without ladies. For we hear of an unfortunate monk who was executed in France so lately as the year 1478 for getting himself with child. (Dr. Fletcher's *Rudiments of Physiology*, P. i. p. 75.)

The ancients believed that mares were sometimes impregnated by the wind, — ἐξανεμοῦσθαι.

> Vere magis, quia vere calor redit ossibus, illæ
> Ore omnes versæ in Zephyrum stant rupibus altis,
> Exceptantque levis auras; et sæpe sine ullis
> Conjugiis vento gravidæ (mirabile dictu)
> Saxa par et scopulos et depressas convallis
> Diffugiunt.
>
> Virgil, *Georg.* Lib. iii.

See also Varro, *De Re Rust.* ii. 1. Columella, vi. 27. and Pliny, *Hist. Nat.* viii. 17.

Under vital and electro-magnetic laws, there take place attractions and repulsions, movements, and new arrangements of particles, and a germinal vesicle is produced, in which the same laws go on operating movements and new arrangements of particles more and more busily, or, at least, more and more visibly. By the union of some particles, and the separation of others (synthesis and analysis), new fluids and solids are produced. Fluidity every where precedes solidity ; and, as soon as solidification occurs, there is organisation. Whether further changes occur in some animals of the same class than in others, is yet uncertain. But Dr. Martin Barry has not discovered the incipient germinal membrane or blastoderm in mammals before coitus, though it exists previously in birds. In whichever way this point is settled, the germinal membrane, spherical and vesicular, is observed, after impregnation, to be the first to change. It becomes more distinct from the yelk and vitellary membrane, and gradually separates into thin layers, lying closely one under another on the yelk, and called by Pander[e] the serous, vascular, and mucous, layers of the blastoderm, which, by the various folds they afterwards form, give rise, — the external to the nervous, tegumentary, muscular, and osseous, systems, and the parietes of the great cavities; — the next, or vascular, to the vascular system; — and the internal, or mucous, which is intimately connected with the middle layer, gives rise, thus combined, to the intestinal, respiratory, and perhaps the glandular, systems.

The cicatricula or germ spot of the common fowl, round, whitish, about a quarter of an inch in diameter, and composed of variously sized granules, lies under the proper membrane of the yelk. Its centre, called the transparent area, or colliquamentum, is the thinnest and most transparent part. Whether any trace of germ exists in it before impregnation, is uncertain. But after incubation has proceeded for seven or eight hours, a dark line, or *primitive trace*, may be discovered in the cicatricula towards the centre of the transparent area, lying in the transverse axis of the egg, and swollen at the extremity which lies to the left when the small end of the egg is turned from us. The large extremity indicates the place where the head is afterwards formed, and occupies nearly the centre of the transparent area; the linear portion corresponds to the tail and body of the fœtus, and approaches the margin of the area on the right side.

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[e] Beiträge, *Zur Entwickelungs-geschichte des Hünchens im Eie.* Wurtzburg, 1817.

As incubation proceeds, the whole cicatricula expands: towards the twelfth or fourteenth hour, the germinal membrane divides into two layers of granules, — the serous and mucous; and the rudimentary trace of embryo, which is now evident, is placed in the outer or serous.

A part of the serous layer becomes thicker, and towards the eighteenth hour displays a long furrow, at the bottom of which is the primitive trace. About the twentieth hour, this furrow becomes a canal, by the junction of its margins, termed plicæ primitivæ by Pander, and laminæ dorsales by Baer. The canal soon becomes closed at the cephalic or swollen end of the primitive trace, at which part it is the widest.

A semifluid matter is now deposited in this canal, which, on acquiring more consistence, becomes the rudiment of the spinal chord. The pyriform extremity or head is partially divided into three vesicles, which, also being filled with semifluid matter, give rise to the rudimentary state of the encephalon, according to Baer. MM. Serres and Allen Thomson confirm his observation.

The serous layer around the spinal canal, especially towards the head, becomes thicker and denser, and, before the twenty-fourth hour, four or five small opaque round bodies appear, indicating the first formation of the dorsal vertebræ. In a few hours several more appear, and the first of them are quadrilateral. From the twentieth to the twenty-fourth hour, the inner layer of the germinal membrane divides, and is converted into the vascular and mucous layers. Towards the twenty-fourth hour, when the layers of the germinal membrane cover near one third of the circumference of the yelk, they begin to exhibit various folds, which afterwards serve for the formation of the cavities of the body. That part of the germinal membrane which lies immediately before the cephalic extremity of the embryo is bent down into a fold, so as to make a depression in the surface of the yelk; and sometime afterwards, a similar fold is formed behind the caudal extremity. As these folds of the germinal membrane in crease, they gradually turn in below the fœtus at its head and tail, and their margins approach one another under the abdomen, which at this period always lies next the substance of the yelk. As the layers of the germinal membrane are bent down in a similar manner towards the sides also of the spinal canal, there is formed, under each end of the embryo, a short sac or cavity, which communicates with the yelk by an opening, common to both, left in its middle. The two short sacs thus formed indicate the rudimentary state of the intestinal tube; the anterior corresponds to the œsophageal portion of the intestine, the posterior to the lower part of the large intestine.

The first rudiments of the heart appear towards the twenty-ninth hour, on the lower side of the œsophageal canal, at the place where the layers of the germinal membrane are reflected from the edge of the anterior short sac which they form in the embryo. In forming this fold, the mucous layer is reflected further inwards, the serous layer advances least, and the space between them, occupied by the vascular layer, is filled up by a dilated part of this layer,—the rudiment of the heart. "About the same time that the developement of these rudimentary parts of the embryo takes place, the surrounding disc of the cicatricula is also considerably changed. The whole cicatricula continues to expand, and to cover more of the surface of the yelk. That part of the mucous and vascular layers which surrounds the transparent area becomes thicker and more spongy than the adjacent parts, and is soon studded with numerous irregular points and marks, of a dark yellow colour: as incubation proceeds, these points become more apparent, and are gradually elongated into small lines, which are united together, first in small groups, and then into one network, so as to form what is termed the vascular area.

"The space occupied by this network is cordiform, and is surrounded by a vessel, gradually developed in the same manner as those of the rest of the area. The newly formed vessels of the space become more and more distinct as ncubation advances, and the orange-coloured fluid they contain assumes a darker hue; the small branches of the network arrange themselves like the fibrils of a leaf, on each side of the embryo, and terminate, towards the embryo, in two vessels issuing from its sides, which are the omphalo-mesenteric arteries. Towards the circumference of the area, the smaller ramifications of these vessels open into the sinus, or vena terminalis, which bounds the space." The leading changes are the same in the germinal membrane of other birds.[f]

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[f] Dr. Allen Thomson's paper *On the Developement of the Vascular System in the Fœtus of Vertebrated Animals; Edinburgh New Philosophical Journal*, July

In regard to mammalia, the ovum of the dog is only $\frac{1}{200}$ of an inch in the Graafian vesicle. On entering the oviduct, it enlarges, and more so as it proceeds; and, having arrived in the uterus, its increase is proportionally more rapid. "According to Baer, and to Prevost and Dumas," "the first trace of the embryo appears like a dark line near the middle of the transparent part, exactly in the same manner as the primitive trace shows itself in the transparent area of birds."

The mucous layer, conformably to its character, absorbs the embryotrophe or yelk, from the first, and converts this to a primitive organic mass on its external surface. Between the serous and mucous layers, the indirect or secondary formations appear: the vascular, arising from the mucous layer, but pushing towards the serous, and developing into the whole vascular system spread throughout the organisation;—and the uro-genital, pushing from within outwards, where, becoming connected with the mucous membranes, and representing, as a partial system, only the eliminating character of them, though of a high kind since it excretes not only disorganised matter, but matter capable of organisation and independent vitality.[h]

In the different ranks of the animal kingdom, the germinal membrane may be entirely changed to an embryo, and thus be all persistent, as in Invertebrata and Batrachians; or partly perish, as in fish, in which a portion of the mucous layer,—the umbilical vesicle, disappears during the embryo state; or a portion of all its layers may be in excess, as in the superior reptiles, birds, and mammals, in all which the peripheral portion of the serous layer constitutes the amnion—a covering to the new being while in utero only; the peripheral portion of the mucous layer,—the umbilical vesicle, the residue of the alimentary canal, partially covering the abdomen of the embryo, and, in some animals, envelope it like the amnion; and the most external of the coverings is the peripheral portion of the uro-genital system,—the allantoid.

The umbilical opening is the point left open in the parietes of

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—October, 1830; from which I have taken the preceding account. For what follows I am indebted to Burdach.

[g] l. c.

[h] Burdach, §417.

the embryo, by which the outer and inner parts of the proligerous membrane are continued, or the point at which the hollow parietes of the embryo are not closed, but reflected upon themselves, to form one substance within these coverings. At first it is nearly as large as the embryo itself, since the inner layer of the proligerous membrane turns and closes all around upon itself, to become insulated and hatched as the embryo, while the peripheral portion expands in the opposite direction — from within outwards: from the first appearance of the embryo, a fold marks the limit of these two portions of the membrane. In proportion as the embryo becomes more insulated, the umbilical opening becomes smaller, and the passage between the embryonic and enveloping portions more cylindrical. Now, as the proligerous membrane divides into an internal and external layer, two umbilical openings are produced, — an external, which is the orifice of the cavity of the body, the parietes of which are continuous with the amnion;—the other internal, which is the cavity of the intestine, and continuous with the umbilical vesicle. There is likewise a third internal umbilical opening, — the cavity of the cloaca or bladder, continuous with the allantoid. There are, consequently, the tubes intermediate between the embryo and its enveloping expansions, — namely, the umbilical sheath, belonging to the amnion; the canal of the umbilical vesicle, with its vessels, belonging to the umbilical vesicle; and the allantoid canal, with its vascular layer, belonging to the allantoid and endochorion. In the superior reptiles, and in birds, these tubular communications are short, so that the embryo and its membranes are in contact: in mammalia they are long, and form the chord termed umbilical, connecting the embryo and membranes, but still separating them. This is longer, absolutely and relatively, in man, — from 18 to 20 inches; while even in horses and horned cattle it never exceeds 12 or 18. In man, too, the tube of the umbilical vesicle and of the allantoid disappear early, so that there remains the umbilical sheath only, and the vessels of the allantoid tube constitute the cylindrical spiral of the chord.

Every animal[i] and vegetable[k], if not every organ, springs, probably, from a distinct vesicle or closed membranous cell, containing some fluid substance, and both cell and contents undergo various changes; and the higher the new individual is to rank, the greater is the number of changes. The various structures of the higher pass through all the changes of the lower. Each structure of each vegetable and animal stops at its own point in the series of changes, and a species is high or low according to the point at which its chief changes stop. The higher the production, the greater, as Harvey first remarked, is the rapidity with which it passes through the series of changes.

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[i] Carus, *Recherches d'Anatomie Philosophique et Transcendentale,* in his *Traité d'Anatomie Comparée,* vol. iii. Paris, 1835.

[k] On the origin of the vegetable cell, see Dr. Schleiden's paper on *Phytoge-*

THE SEROUS LAYER. — In man and other vertebrate animals, the *brain* and *spinal chord* are the first parts formed. They are produced upon the central part, or *first zone of the external surface of the serous layer*, in the form of a liquid enclosed in a covering; a solid matter is precipitated from the surface towards the centre, consisting of opake granulations, united by a transparent viscid fluid: at this time there are neither blood nor blood-vessels. After the third month, the substance, which has become more and more solid, separates into the fibrous and pulpy portions[1]; and, still later, a slight difference of colour is observed. These changes occur earlier in the chord than in the brain: and, though the brain may be to the spinal chord regarded as about 40 to 1 in the adult, 107 at ten months from conception, 63 at five months, it is but as 18 at three months. The covering of the brain and chord gradually divides into pia mater and arachnoid; and the latter is soon thicker and more opake than in the adult. The brain and chord are both produced in their whole length at once. The

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nesis, in Taylor's *Scientific Memoirs,* No. vi. Aug. 1839, from Müller's *Archiv für Anat. und Physiol.* P. ii. 1838.

[1] Tiedemann contends that the fibrous portion of the spinal chord is formed before the pulpy. Yet he allows that all the nervous matter is first "*a liquid and transparent fluid*" during the first month, and "a soft and pultaceous mass towards the end of the second;" that no fibres can be discerned even with the microscope at the beginning of the third; and that the constant result of his examination of fresh fœtal brains is that the cortical and medullary parts are indistinguishable, being homogenous and reddish white, though the external may be softer and perhaps a little more supplied with vessels. Gall tells him that "if he would allow the veil of prejudice to drop from his eyes, he would see, as he states most explicitly, that the pia mater with its numerous vessels, and a substance, liquid, successively glairy, pulpy, gelatinous, reddish, exists before any trace of fibrous substance." (*Fonctions du Cerveau,* t. vi. p. 67. sqq. See *suprà,* p. 341. sqq.)

chord is at first $1\frac{1}{2}$ line in length, and has one extremity dilated to a hollow nodule, which is the rudiment of the head. The brain is at first semicircular, and the spinal chord tubular; the lateral parts are thicker, and their union presents a fine plate only. The lateral parts, and especially the lower portions of these in the brain, and the anterior in the chord, grow the most, and begin to exhibit fibres the soonest; and the union of these portions at the median line is from the first the strongest, and it is persistent. The upper portion of these in the brain and the posterior in the chord grow slowly, and so much in breadth outwards, that a groove is left at the upper part of the brain during the sixth week, and in the posterior part of the chord from the end of the second to the fifth month. As the sides of the chord grow at its posterior parts, towards their middle, they at length touch each other and unite, so that the groove becomes a canal, observable till the sixth month, or even later. The same happens in the brain; but the union is never complete in every point, so that the ventricles are left.

The original cavity of the brain and chord diminishes and in some points is completely filled up by internal deposition, which is more abundant than deposition without, so that their bulk proportionally to the whole body diminishes.

In the chord, the pulpy substance preponderates in the four chords and circumference of the canal during the whole of fœtal life.

The canal of the chord remains open in other mammalia, and does not close completely at the neck in the human embryo. The chord is as long as the spine during the first three months only; from this time it grows so much less than the spine that at the seventh month it reaches to the last lumbar vertebra only, and at the ninth only to the first.

The brain originally consists, as in all mammalia, of three vesicles, which are the rudiments of the chorda oblongata, the corpora quadrigemina, and the cerebrum. They lie in a series, and are filled with a clear fluid, not divided at the median line, distinct, and in some measure independent of each other; and the cerebral trunk forms various curves, downwards where it is to produce the chorda oblongata, upwards where it supports the corpora quadrigemina, and downwards at an acute angle, to support the thalami optici. It afterwards takes a more uniform direction, and the individual parts become more concentrated and united. The brain grows more in breadth at the fourth month only, but afterwards more in length proportionally, till at nine or ten months the proportions of the two are nearly the same as in the adult. The brain is proportionally larger than in the adult. Its weight is about $\frac{1}{8}$ of that of the body at the fifth month, and about $\frac{1}{10}$ at the tenth, whereas it is about $\frac{1}{40}$ in the adult.

The *chorda oblongata*, or posterior of the three vesicles, at first forms an angle with the spinal chord, and is much more developed proportionally than the rest of the brain; and this proportion does not afterwards diminish considerably. Tiedemann states that its component breadth is as 1 to 1·25 in the second month, and as 1 to 6 or 7 in the adult; and nearly half as broad at ten months as in the adult.

The decussation of the anterior pyramids is visible after the fifth week, and the corpora olivaria soon afterwards appear, as little branching cavities, which are filled up at the sixth month. The chorda oblongata is of a uniform redness throughout the fœtal state.

The *cerebellum* is not an original part; it arises between the chorda oblongata and the tubercula quadrigemina. Bands from the posterior and lateral parts of the chorda oblongata give origin to the posterior crura of the cerebellum, produce an arch, and touch in the median line. But these crura appear formed in the whole length from the first, in the sixth or seventh week, as two fine plates extending to the median line, and at the beginning of the third month coalesce and enclose a space,—part of the rhomboidal sinus, which afterwards becomes the fourth ventricle. In the fourth month the ciliary ganglia or corpora fimbriata appear as closed vesicles, supplied freely with blood-vessels. In the fifth month, the hemispheres of the cerebellum begin and grow chiefly forwards. Between the layers of the cerebellum, produced by fibres radiating from the spinal chord, fresh layers are deposited in different directions, and the mass divides into five stems. The four furrows between them begin most conspicuously at the vermiform process. In the sixth month, the stems divide into branches, the lobes into lobules, and the cavity of the cerebellum narrows. In the seventh, the furrows are deeper and more numerous, the tufts and posterior valve appear. In the eighth month, the hemispheres are more developed below and behind, the ultimate divisions of the branches take place, and almondlike lobules are produced: the fibrous and pulpy substances become distinguishable from each other by their colour.

The pons varolii appears about the beginning of the fourth month. The posterior part is first formed, so that the fifth pair arises from its anterior edge. Its diameter from before backwards is 1 line in the fourth month; 2 in the fifth; 4 in the ninth; 15 or 18 in the adult. The ascending prolongations, with the valve, are developed as the vermiform process grows thicker, are a fine plate, and advance towards the tubercula quadrigemina.

The cerebellum of the fœtus does not increase in volume so much as the rest of the brain. Its weight in the fœtus, compared with that of the cerebrum, is 1 to 23 at the full time, whereas in the adult this is as 1 to 7. The greater simplicity of its organisation occasions, however, its texture to be perfected sooner than that of the cerebrum.

The *tubercula quadrigemina* are original formations; and are seen at the first in the median line as a single bladder filled with clear fluid, behind the cerebrum, and before the chorda oblongata, which is higher than either. The fluid coagulates and becomes a fibrous plate on each side. These are separate at the median line from about the sixth to the ninth week, and are two hollow hemispheres at their lower part, and parted by a longitudinal fissure. The space which they enclose is a continuation of the rhomboidal sinus, and, like this, is a gutter only, opening by a slit. At the end of the third month, the two plates meet, and are joined by the ascending peduncles of the cerebellum. In the fourth month, they coalesce and inclose a vast cavity. The predominance of lateral developement soon occasions a longitudinal median furrow; a transverse furrow also takes place: and thus the four quadrigemina are produced. In the sixth month, the tubercles are covered by the cerebrum; a layer of pulpy substance is deposited on their surface, and fibres also are visible. At the seventh month, they are so thick that their cavity is reduced to a canal — the aqueduct; analogous to that of the spinal chord. They are always of nearly the breadth of the chorda oblongata, and, like it, larger proportionally to the cerebrum, the younger the fœtus; and in the uterus they acquire more than half the size which they attain in the adult.

The third primitive part is the cerebrum. The *crura cerebri*,—prolongations of the anterior bands of the spinal chord, are developed very early, and are therefore larger proportionally at first than afterwards, and become firmer towards the end of fœtal life while the other parts of the cerebrum are soft. About the fourth month, the layer which lies upon them is still more developed by the increase of the posterior bands of the spinal chord, and the constantly increasing prolongation of the fibres proceeding from the corpora quadrigemina. The crura cerebri are very early divided by a slit, so that a gutter, open above, remains till they are covered by the hemispheres. In the region of the tubercula quadrigemina, they bend at an acute angle towards the base of the cranium. This flexure, which is gradually effaced, seems to indicate the formation of the *infundibulum*, which is, a prolongation of the grey chords that lie on the anterior bands of the spinal chord, whose canal they enclose, and is a primitive part, according to Baer, constituting the cephalic extremity of the cerebrum. The tube of the infundibulum is continued to the pituitary gland, which, till the sixth month, has a cavity that is really the extremity of the canal of the spinal chord, and is ultimately obliterated, as well as the lower part of the hollow of the *infundibulum*. The gland is at first proportionally larger than the brain; being, at four months, as 1 to 9·50; in the adult, as 1 to 18.

The *ganglions* of the brain (thalami optici and corpora striata) sprout from the crura cerebri simultaneously in the eighth week, and undergo no remarkable changes.

The *thalami*, towards the end of the second month, are hollow. They become proportionally more voluminous than in the adult. They turn fibrous, but remain red. The commissura mollis forms in the fourth month; the posterior at the end of the third, and seems to result from a fold of the portion still remaining of the vault of the vesicles of the crura cerebri. The elevation of this vault produces the *pineal gland*, which becomes thicker, but remains destitute of grit.

The *corpora striata* grow much faster than the thalami.

The crown which radiates from these ganglia forms the *hemispheres*. Its increase arises from fibres more and more parallel being applied to the lower edge of its anterior and posterior extremities. The hemispheres are originally an undivided vesicle, which afterwards has a longitudinal depression. Up to the third month, they consist of fine plates, ascending from the external and anterior part of the corpora striata. They become larger from the rays of the crown multiplying and lengthening; and thicken both by the augmentation of its fibres that lie side by side, and by the addition of the uniting parts. They soon preponderate over the chorda spinalis and oblongata, the cerebellum and and corpora quadrigemina; and even more in the embryo than in the adult. For the breadth of the cerebellum at two months is to that of the cerebrum as 1 to 0·75; at six months, as 1 to 1·87; at nine, as 1 to 2; at ten, as 1 to 1·93; and in the adult, as 1 to 1·25.

Towards the end of the third month, the *uniting parts* commence; whether produced from the primordial parts, or precipitated upon these from some new fluid effused. The fore part of the *corpus callosum* first appears, and under the form of a plate lying perpendicularly before the corpora striata, which it covers at the fifth month. The corpus callosum covers the thalami at six months; and at the eighth month extends beyond them, forming the ventricles. The anterior parts of the *fornix* are formed at the same time with the corpus callosum. At the end of the third month, the fornix is composed of the mamillary eminences, which are at present a single mass of the ascending pillars in the thalami, and of the anterior pillars which ascend behind the fore part of the fornix, without touching, bend backwards, but do not reach above the thalami, and are lost in the hemispheres. At the fourth month, these pillars touch each other behind the fore part of the corpus callosum, and extend backward to the inferior cornua.

The *anterior commissure* is seen in the third month.

The peduncles of the *septum lucidum* spring up probably after the end of the third month: but their plates, or the septum itself, do not appear till the fifth month, between the corpus callosum and fornix. They as yet are not in contact; but leave an open space till the latter months, when they unite below and behind, producing the fifth ventricle, which gradually diminishes.

The fibres of the rays of the hemispheres separate towards the surface, and in the spaces uniting fibres are deposited, which have their extremities in the surface, and pass from one plate to another, folding upon themselves at the bottom of the spaces. Thus the convolutions are produced — first, in the fifth month, at the inner surface, and inner part of the upper surface; and, in the seventh month, at the upper and outer surface. They gradually augment in number and depth, but never become very marked during fœtal life.

The *ventricles* of the cerebrum are originally close and undivided. When the anterior encephalic vesicle opens, the third ventricle appears as a gutter between the thalami, continuous with that of the spinal chord by means of the rhomboidal sinus and the fourth ventricle. When the hemispheres grow, the lateral ventricles appear, open by a central fissure. The formation of the corpus callosum closes them above at the end of the fourth month, and their closure is complete at the end of the eighth. At the fifth, they begin to be separated longitudinally from each other by the septum lucidum; an opening, however, being still left below the pillars of the fornix. The cavity is at first continuous, before and above, with that of the septum; before and below with those of the olfactory bands or nerves; and directly below with that of the infundibulum and pituitary gland. Towards the eighth month, the cavities of the two latter are obliterated, and the opening of that of the septum closes. The plexus choroides are formed at the end of the third month, and soon become so voluminous as to almost fill the ventricles. The capacity of the lateral ventricles increases with the bulk of the hemispheres; and diminishes again after the seventh month, as these grow thicker.[m]

The *second zone or excentric part of the serous layer*, according to Burdach, gives rise to the nerves, muscles, bones, and skin, the animal periphery, as he calls the assemblage of these parts, surrounding the encephalo-spinal organ, which we may regard as the being itself, and protecting it, subservient to its connections and operations with the surrounding world, and likewise protecting and forming parietes for the other organs. These peripheral parts are not produced by the encephalo-spinal organ, and may be formed when it is not, — when there is neither brain nor spinal chord, but are in harmony with it. At first, this portion of the serous layer is the transparent envelope of the embryo, and unites in the median line. Then it becomes granular and opake by the addition of primordial matter, and first at the sides of the encephalo-spinal organ, from which parts they spread to the median line. It afterwards separates into the true animal periphery, skin, — bone, muscles, and nerves. These changes take place from within outwards, and thus at different times in different parts: so that all these states may co-exist in different points.

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[m] The Commissioners of the French Institute, who drew up the Report upon Gall's discoveries that was thought to have annihilated them, declared that there was no successive developement of the nervous system. " Dans le système nerveux, tout est formé à la fois." This Gall knew to be erroneous, and refuted at length before Carus, Tiedemann, or others published upon developement. " Dans un fœtus humain d'environ six mois, les nerfs de la colonne vertébrale, des muscles de l'œil, et les nerfs tri-jumeaux sont plus tôt formés que le nerf olfactif, et celui-ci l'est plus tôt que le nerf auditif, le nerf optique, les pyramides et la protubérance annulaire, dans laquelle l'on découvre à peine des traces de filamens nerveux. Les pédoncules du cerveau, sur la surface desquels les faisceaux de filamens sont si visibles par la suite, paraissent ne consister alors que dans un amas de substance grise, les couches optiques, les corps striés, et les hémisphères ne contiennent encore aucun filament distinct (sans préparation et à l'œil nu); on les découvre plutôt dans les lobes postérieurs et moyens que dans les antérieurs," &c. (*Anatomie et Physiologie du Cerveau*, t. i. p. 240. 4to. 1810; also, *Fonctions du Cerveau*, t. vi. p. 48. sq.; and his *Recherches sur le Systême Nerveux*, p. 149. sq. 1808.)

The serous wall may be regarded as the primitive *skin*, before the skin itself exists. This, when first distinguishable from subjacent muscles, is soft, and does not acquire more solidity till the middle of fœtal existence. Sebaceous follicles appear at the third month: after the fifth, these secrete the vernix caseosa. The epidermis is distinguishable after the second month, resulting apparently from an albuminous matter poured out upon the skin. The nails are distinguishable at the third month. The hairs are formed as brown or black spots under the epidermis about the beginning of the fourth month; at the beginning of the sixth, a soft down covers the body, and falls off again by the end of the tenth month: the hair of the head, the eyebrows, and eyelashes, sprouts forth at the sixth month.

The *bones* are at first a mere jelly, — granulations lying in a more translucid mass: this jelly, in the fifth week, begins externally to become cartilage, perfectly transparent, homogenous, without cells or blood-vessels, and no granular matter is at length left. Cartilaginification is first observed around the heart, in the vertebræ, ribs, and sternum: it occurs in patches, thus indicating the future articulations; and the granular mass which remains undivided at these is gradually converted into articular ligaments. This detached conversion to cartilage for each distinct future bone does not occur when several bones are to be fixed immoveably together, as in the case of the head and pelvis.

Each cartilage has a very delicate fibrous sheath; and the vertebral column evidently has one while it is still jelly. At length blood-vessels enter the cartilage through the fibrous investment it becomes opake; inflexible; uneven on its surface: fibres, parallel, at right angles to each other, or united by others which are transverse, appear, and an areolar tissue is thus produced. The earthy matter of the blood is deposited in the cartilage, but so combined that the new bony portion is easily separated from the rest, and, if we remove the earth, a jelly is left rather different from that of mere cartilage. Valentin has recently stated that the cartilaginous granulations become long bony corpuscles, pointed at their two extremities; and that spherical cavities take place in the cartilages, and lengthen, communicate, and represent the canals of the bones. Ossification begins in the seventh week: we observe it at one point only in some bones; at two, and even more, in others. The os humeri has seven points of ossification, the occipital twelve, the sphenoid fourteen, and the sacrum twenty-one. Each point enlarges; and, if there are more than one, they at length touch and unite. Many of the apertures and canals for vessels and nerves form between two bony nuclei, originally separate; some are formed by the deposition of bone around the vessel.

The first point of ossification is in the clavicle, near the end of the second month: the next in the upper and lower jaw, and the os femoris. In the first half of the third month, ossification commences in the frontal and occipital, the humerus, radius, ulna, tibia, fibula, scapula, and ribs; in the second half, it begins in the temporal, sphenoid, and malar; then in the parietal, palatine, and nasal; and, ultimately, in the vertebræ, metacarpus, metatarsus, and last phalanges: in the fourth month, in the vomer, the two other phalanges, and the ilia; at the fifth, in the ethmoid, lachrymal, and turbinated; at the sixth, in the sternum, carpus, and tarsus; at the seventh, in the hyoides and coccyx. The order of ossification differs from that of cartilage, and depends upon the distribution of the blood-vessels. It almost universally begins at the same time in very distant points, and generally proceeds from the sides towards the median line, where the blood-vessels first penetrate and are the largest: thus the first formed bones are either pairs for life, viz. the clavicles, upper jaw and femur; or at first, as the lower jaw and frontal. In odd bones, the lateral parts are equally formed the first: for instance, the arches before the bodies of the vertebræ; the lateral parts before the cuneiform of the os occipitis; the wings before the body of the sphenoid; and the lateral masses before the perpendicular plate of the ethmoid. The sacrum, however, is an exception, as its body is ossified before its arches. Certain odd bones are, therefore, pairs at first. Ossification always commences within, and spreads gradually outwards, except in the last phalanges, which first ossify at their summits.

The bony substance continues to be of a greyish red and flexible in the fœtus; and the blood-vessels diminish as it approaches its full term. The periosteum is thicker, more vascular, and more easily detached than in the adult. No bone, at first, has its future permanent form. The cavities of the long bones, and that of the tympanum, increase with the substance; proving that there is a continual absorption and formation.

The epiphyses, while cartilaginous, are continuous with the body of the future bone; and only separate from it, when both, having ossified, come in contact and the periosteum adheres strongly to the surface of each. The concave surface of the epiphysis rests upon the convex surface of the shaft, from which it receives large blood-vessels; and, ultimately, the two parts become one.

When there is an articulation, ossification does not extend to the extremity; but the last layer of cartilage remains unchanged, to become the articular cartilage. A medullary cavity is seen early in the long bones, and is soon closed at its ends by bone, after which cells are at length produced full of reddish and gelatinous substance. There is no cancellated structure or marrow in the flat bones during fœtal life. At the full time, the superior cornua of the os hyoides, the patella, the lower portion of the coccyx, the four upper carpal bones, and the great and little quadratum, are still cartilaginous. In other bones, certain points only of ossification have not yet appeared: for instance, at the perpendicular plate of the ethmoid; the processes of the scapula; the upper end of the humerus and phalanges; the lower end of the tibia, metacarpal, and metatarsal bones; the upper end and trochanters of the femur; the posterior end of the ribs; both ends of the radius, ulna, and fibula; the body of the atlas. Some bones are still ununited: the frontal, ethmoid, lower jaw, humerus, and femur, are in 2 pieces; the sphenoid, ilia, and vertebræ, in 3; the sacrum, in 21. The bones of the ear only are perfect.

The basis of the skeleton is the bodies of the vertebræ and the analogous portions of the cranial bones. The spine begins to ossify at its middle; so that, about the tenth week, the 8 lowest dorsal and 4 upper lumbar vertebræ exist; in the eleventh week, the 3 lower cervical, 4 upper dorsal, and 5th lumbar are added; in the fourth month, the 3d and 4th cervical, and 4 superior sacral; at six months, the 5th sacral; at the seventh, the 2d cervical; at ten months, the atlas and 1st coccygeal bone. The cranial vertebræ begin to ossify about the same time; but from before backwards. The first bony points appear at the third month, in the cuneiform process of the occipital bone; at the fourth, in the posterior sphenoid (middle cranial vertebra); at the seventh, in the anterior sphenoid (anterior cranial vertebra). The spine is at first very flat in front, and does not project forward till the end of the second month. The bodies grow more slowly than the arches; so that the vertebræ are at first more annular than subsequently. The spinal and cranial vertebræ at first constitute the whole length of the body, and do this less and less only as the legs push forth. The base of the cranium is long gelatinous; at the end of the second month it becomes cartilaginous, and contracts upon itself as the cerebral parts become more concentrated. The lower part of the spine, or the tail, precedes the limbs, and is greatly developed at two months; but, as it is not destined for any function in man, it diminishes at this time during cartilaginification, and becomes lost in the parts of the pelvis which now develope themselves.

The *muscles* are visible at the end of the second month, gelatinous, pale, yellowish, and transparent. Granulations of the primordial mass are disposed in lines, which afterwards lie closer together, and form filaments that gradually become smooth transparent cylinders, with traces of transverse striæ after the sixth month, at which time they begin to be thicker and reddish. The fibres subsequently divide into fibrils. Between the muscles and their fibres, globules are seen, which become cellular membrane. Tendons are produced in the same manner as muscles, but earlier, and are seen as viscid transparent cylinders while the muscular substance is still granular. In monsters with neither encephalo-spinal organ nor nerves, there are no muscles, but merely a sort of gelatinous spongy cellular substance; and, if a portion only of the encephalo-spinal organ is developed, the muscles are developed at certain points only. The muscles appear at different periods in different regions of the body; but each appears at first of its whole length.

The *nerves* have been said by some to shoot inwards from the circumference to the encephalo-spinal organ; and, by others, from this to the circumference. The optic, auditory, and olfactory nerves, or rather the organ of sense of which they form a part, arise from portions of the brain. These three nerves are original tubular projections from the ventricles of the brain. The rest of the brain may be absent, and yet the fundamental portion which gives rise to these be present, as well as the respective organs of sense with their nerves. The particular fundamental portion may be present, and yet not develope itself into the apparatus of sense. It would appear, also, that the apparatus of these three senses may be more or less developed without apparent connection with the brain. Morgagni once found perfect eyes with their optic nerve terminating in the orbits, and only two small masses existing instead of brain. Here the points of communication with the brain had atrophied long before, and yet the developement of the nerve, &c. had still gone on. A solid membrane full of fluid, in place of an eye, has been found without any nerve. From all these facts, some consider that the portion of the organ of sense nearer the brain and that which is distant are more or less independent, but still have a relation to each other so as to form together a perfect organ, though without farther influence from the brain. Fœtuses, destitute of brain and spinal chord, with rudiments of feet and toes, nay, single limbs, have existed, and yet no nerves have been discernible. Now, when nerves exist, we cannot suppose that they have sprouted into the limbs from the chord, or the converse. Again, in proportion as organs grow, do their nerves grow thicker by the multiplication of their fibres. Thus the fifth pair has 18 chords at eight months; and 28 or 30 at birth. In acephalic fœtuses, the spinal nerves sometimes cease at a short distance: sometimes the nerves of the limbs cease at the membrane of the chord: sometimes a nerve is absent for a considerable part of its course. All this makes it probable that all the points of the nerves form more or less independently, and unite harmoniously into a whole.

The encephalic nerves are larger proportionally to the brain in the fœtus than in the adult. At the fourth and fifth month, the great sympathetic is more developed than the other nerves, and its ganglia are so large as almost to touch and form an uninterrupted series: after the sixth month, it diminishes and acquires nearly its permanent proportions.

From these elements, with blood-vessels and lymphatics, the peripheral portion of the animal is formed. This comprises two parts; the common, or parietal, and the special, which is divided into two classes of organs.

The posterior part of the parietal, or that which encloses the encephalo-spinal organ, appears the first, beginning at the sides and extending to the median line till junction is effected. The anterior is that which encloses the viscera destined for the maintenance of the encephalo-spinal organ. This cavity communicates with the fœtal coverings, is formed late, and continues in relation with them by means of the umbilicus. The anterior part of the parietal is a portion of the serous layer originally applied to the vascular and mucous: and when these, by contracting more powerfully than it, separate from it, a cavity is left. It also begins at the sides, and extends to the centre till junction is effected. Like the posterior part of the parietal, it forms osseous arches at the chest (ribs), but less after a fixed type, for they are absent in the neck and abdomen and are united into a mass below (pelvis).

At some points the anterior parietal detaches itself inwards, and forms a septum (diaphragm); or, with the developements of the mucous layer, becomes a muscular layer (the tongue and velum palati); or developes itself in the form of a cartilaginous apparatus provided with muscles (the larynx and trachea). The posterior parietal here and there, also, emits prolongations, as the lower spinous processes and septum of the nose.

The anterior cavity assumes a particular form in the different regions. 1. The neck, being at first as broad as the trunk, appears not to exist. The heart is enclosed in it, as we find to be permanently the case with fish. When the heart descends and tubular parts only exist between the head and trunk, the anterior parietal shrinks at this point, a sort of strangling takes place, and we see a cylindrical neck. At the fourth month, when the larynx, thyreoid, and thymus are chiefly developed, the transverse processes grow more at the cervical than at the other vertebræ. The ribs appear as white streaks in the walls of the chest during the sixth week. In the eighth, they divide into two cartilaginous portions, only one of which ossifies. This it does rapidly, but not beyond the head and tuberosity during fœtal life. The sternum is very short in the eighth week, and consists of two cartilages, one of which is persistent, — the ensiform. The diaphragm does not exist before the third month, and has few muscular fibres till the fourth. The tendinous part for some time constitutes a great proportion of it, and is closely united with the pericardium. In the seventh week only do the abdominal parietes become opake. The navel, at the beginning of the second month, is almost at the lower extremity of the trunk, and is situated proportionally higher up when the hypogastric region becomes developed at the end of the month. It constantly diminishes in proportion to the body, although absolutely larger from the increasing diameter of the umbilical vessels. A cartilage appears on each side in the eighth week, as the rudiment of the pelvis, which is developed in direct proportion to the contained organs.

The organs of the peripheral portion of the second zone of the serous layer are those of sensibility and of irritability. They are disposed to be in pairs; and in the monocular pulex, which has but one eye, there are two originally. They are closely related to each other, for the limbs are organs of sense; and in the lower animals the organs of sense are formed like limbs. The organs of sense and the limbs are, as it were, radiating organs; those of the brain, these of the spinal chord; produced by a harmony between the encephalo-spinal organ and the peripheral portion of the second zone of the serous layer. The organs of sense spring from an encephalo-spinal nucleus and a peripheral deposition from this second zone of the serous layer, and the limbs from this peripheral zone and are subsequently brought into relation with the spinal chord by nerves.

The eyes are the first organs of sense. They soon grow very large proportionally, and do not diminish till near the full time. The optic nerve is a fine gelatinous band in the sixth week; a hollow cylinder in the third and fourth month, communicating with the ventricles of the brain; and is not solid till towards the seventh month. The retina is originally thick, flocculent, and folded. The interior of the eye, circumscribed by the retina, and continuous at first with the encephalic cavity, is lined by the hyoloid membrane. The lens is at first spherical, and so bulky in the embryo of six weeks as to fill the eye and touch the cornea, which is flat. It is at first a liquid in a very vascular capsule. The vitreous body is formed afterwards; and then the chorioid, as a continuation of the vascular layer, between the central and peripheral productions of the serous layer in the eye. Black and yellow spots of pigment are deposited in it from before backwards at six weeks; at three or four months, its anterior edge folds, and forms the ciliary body; at five months, the ciliary processes appear. Soon after this the iris comes from the anterior edge of the chorioid, which till now formed the pupil. The anterior chamber is gradually produced; and in its interior a close serous vesicle, the front of which lines the cornea, and the posterior covers the iris and blocks up the pupil, and unites with a membranous layer bound to the back of the iris. At the eighth month, the part of it in the pupil,—membrana pupillaris, not being able to follow the growth of the iris, becomes tense and lacerates. Before this event, the posterior chamber scarcely exists. Müller has discovered a close sac, extending from the anterior chamber of the eye, passing through the pupil to the edge and back of the crystalline, and named capsulo-pupillary membrane, which has only a transitory existence, and such a double follicle is supposed to give origin to the crystalline. The secretion into the serous membrane becomes so abundant in the fourth month, as to render the cornea more prominent. The sclerotic is at first transparent, and gradually becomes firm and fibrous. At the third month, its anterior segment begins to become prominent and pellucid, as a cornea. The eyes are at first very prominent, and at the sides of the head, as in brutes. They begin to retire into the head at the third month, as the orbits form; and they become situated in front as the head grows broader. The muscles of the eye appear at the third month, as gelatinous chords. At the second month, the skin passes over the eye. At the beginning of the third month, a fold forms at the front of the eye, like a ring; and, before the end, is converted into perfect eyelids, glued together. The conjunctiva is then a vesicle. The eyelids separate in the seventh or eighth month, at the time the membrana pupillaris disappears. The eyelashes appear towards the ninth month.

According to Baer, the central part of the auditory apparatus begins, soon after the eye, as a hollow cylinder, from the side of the chorda oblongata. This cylinder solidifies nearest the chord, and becomes the acoustic nerve, and its posterior portion remains hollow. The labyrinth is first formed; and the vestibule is, probably, the primitive part, dividing into cochlea and semicircular canals, which are perfectly formed at the beginning of the third month, lined by a membrane which disappears in the seventh month. Around the labyrinth a jelly is deposited, which at the commencement of the third month becomes cartilage, distinct from the petrous portion, beginning to ossify before it, entirely ossified in the eighth month, and afterwards united with the petrous portion. Ossification begins at the end of the third month, in the three parts of the labyrinth at once: in the cochlea at the fenestra rotunda, proceeding forwards, reaching the spiral lamina the last; in the vestibule at the fenestra ovalis; and of the semicircular canals the superior ossifies first, then the posterior, and at the fifth month the external. The Eustachian tube is at first very large, and is invested with cartilage at the third month. The cavity of the tympanum is proportionally small, and filled with a reddish thick fluid. A wart at its back part is said to produce the anvil and hammer; a second wart produces the stirrup. The cartilaginification of these begins early in the third month, in the hammer and anvil, and then in the stirrup. Ossification soon follows in the two former, and first in the hammer; and is finished in the seventh month. At the tenth month, these bones have attained their permanent size. The frame of the tympanum appears in the second month; its ossification begins at the end of the third. It is long open at its upper and front part, grows till the eighth month, is round, afterwards broader and more elliptical, and at last unites at its extremities with the malar portion of the temporal bone. The membrana tympani is proportionally greater, more rounded, and oblique downwards and inwards, than in the adult; as well as nearer the surface, since the meatus auditorius does not yet exist. The external orifice of the ear is discernible in the sixth week, near the corner of the mouth, as a mere point or oblong depression which becomes the meatus. In the eleventh week, this is closed by a sort of membranous plug in contact with the membrana tympani. The outer ear begins in the eighth week as a fold of integument, which is flat during the ninth week and begins to become cartilage at the end of the third month. The middle of the helix and antitragus appear first, then the tragus and antihelix; at the fifth month, the concha; at the sixth, the upper part of the helix and the lobule. After this, it begins to stand more from the head: at the tenth month, it is rather firm; but cartilage does not yet completely fill the fold of skin.

The limbs, at six weeks, are round tubercles, which are deeply attached at one point and free at the other. The gelatinous germs of the tubercles come from the sides of the vertebral column. They are at first thick, and grow slender as they lengthen; but are not rounded till the latter months. The tubercular portions of the thigh and arm continue for a long time applied to the trunk under the skin, as is permanently the case in most mammalia, without a cylindrical covering from this. After the fingers and toes are separated from each other, they are still covered with, as it were, a mitten of skin, which gradually disappears between the fingers, so that its edge at first seems notched; and, when it begins to detach itself, the fingers are united by fine cutaneous expansions.

When the gelatinous nucleus has attained a certain length, it divides into many segments produced by condensation and constriction; but this division is not complete, on account of the synovial capsules, ligaments, and skin, which bind together and insulate the individual portions. The division is, at first, into a cylindrical and flat portion. The flat (hand, foot) is terminated by a rounded point. At length the cylindrical divides into trunk and branch; and the latter (forearm, leg) continues for some time short in comparison with the flat part. Some one or more of these divisions may not take place, so that the carpus may not exist between the forearm and metacarpus; the forearm may join the scapula; or the hand be seen without fore or upper arm: for one part does not shoot from another. When the limbs begin thus to divide, the clavicles, and scapulæ, and pelvic bones appear at their roots. Ossification begins earlier in the clavicles than in the scapulæ and pelvis; in the femur and humerus, than in the bones of the leg and forearm; and earlier in these than in the metacarpus, metatarsus, fingers, and toes; and in these, than in the carpus and tarsus. The limbs at first differ in situation only. The upper extremities appear at a much more early period before the lower than in brute mammalia; and the enlargements of the spinal chord for their nerves are greater than those for the nerves of the lower. The clavicle is ossified in the seventh week, and is for some time the largest bone, four times larger than the femur. The scapula ossifies soon afterwards. The ilia not till the fourth month, at which time the pelvis is very narrow, and the shoulders pretty well developed. At the end of the tenth month, the breadth of the great trochanters is 3½ or 3¼ inches; while that of the shoulders is 4½ or 4¼ inches. In the eighth week, the femur is still under the skin, while the humerus is free. The metatarsus ossifies after the metacarpus: the toes ossify and divide after the fingers. Nevertheless the femoral and tarsal bones, being required for support, ossify before the humeral and carpal. At the fourth month, the lower extremities are as strong as the upper; and at the fifth, more muscular, for the nates are sketched, the thighs are more fleshy, and the calves project. The limbs are at first perfectly extended, like the shoots of plants. But, when the muscles are developed, they become bent: the arm lies against the chest, the forearm is directed upwards and inwards; the thigh lies against the abdomen, the leg against the thigh, the foot against the leg; the fingers close in the twelfth week; the hands are applied to the chest and lower part of the face; the feet cross, with the sole turned inwards towards the genitals.

There remains another peripheral portion of the serous layer, seen in the fowl to be reflected from the sides of the yet unclosed anterior parietes, and to proceed towards the posterior surface of the embryo, there to be constricted towards the centre, and then be reflected outwards again, and apply itself to the membrane of the yelk: an opening is thus left in it at the back of the embryo, which is at length closed by the approximation of its edges. The amnion is thus produced. The outer layer, which comes from the edges of the opening in the amnion (and is called by Pander the false amnion), covers the amnion, extends to the outer edge of the membrana proligera, and ultimately unites with the allantoid. The same process, more or less modified, probably goes on in the human ovum at a proportionally early period. The amnion, like all other serous membranes, is a bladder consisting of two parts. The external — properly the amnion — is turned towards the chorion, and reflected along the chord, as a sheath, till it reaches the surface of the child, which it envelopes just as the pericardium does the heart, being continuous with the skin. The chord is at first short and thick, enclosing the vesicula umbilicalis, the middle part of the alimentary canal, the allantoid, and the omphalo-iliac vessels. It afterwards lengthens, loses its thickness, and contains these vessels only, with the remains of the umbilical vesicle and allantoid. Its continuation with the skin is easily shown, since the latter for some time preserves its serous character.

THE MUCOUS LAYER.—This grows immediately around the yelk in birds, as the vitellary membrane did before its absorption, becomes the *vitellary sac*, and is gradually converted into the alimentary canal. The umbilical vesicle of mammals corresponds perfectly with the vitellary sac; and the mucous layer has always been seen in mammalia in the form of a vesicle, and therefore probably from the first enclosed the original embryotrophe as a vesicle, since the original embryotrophe in them, corresponding with the yelk of birds, is so inconsiderable that a small vesicle may contain it, on account of the body of the mother supplying the nourishment, whereas in birds the yelk becomes very large, in order to afford nourishment during the whole time of incubation. Burdach gives the name *intestinal vesicle* to the umbilical vesicle and that elongation of it which becomes the alimentary canal. In birds, the yelk, soon after its production, becomes covered with the vitellary membrane through which additions to its substance pass; for yelk globules have been seen outside the membrane in progress to the yelk within. The white also penetrates to it through the vitellary membrane or the mucous layer which supplies its place. The umbilical vesicle and its contents in mammalia grow considerably before the appearance of the embryo or its vascular system; and this must therefore be by absorption through it; and its contents cannot therefore be secreted by the omphalo-mesenteric vessels. In vertebrate animals, the vesicle becomes divided by a circular lateral fold into two parts,—the one internal, below the spine and cranium, elongating itself more and more, and persistent; the other nearer the front, continuing to have a more or less globular form, and wasting away in time. The folding takes place sooner at the upper and lower parts than at the sides, so that first an oral and anal portion of the alimentary canal are produced: then the folding proceeds at the centre, and the middle or small intestine is produced; and of course at its centre is a communication with the portion which remains globular.

The opening of communication gradually narrows, and the part of the intestinal vesicle next it lengthens, so that a *vitello-intestinal canal* forms. All the process is presumed to be nearly the same in man; in whom the opening of communication has been seen by Velpeau and Müller, and Tiedemann has seen in the human umbilical chord of a fœtus, though of low developement at many points, at full time, a pyriform vesicle above 14 lines long, and 7 broad, opening into the intestine by a pretty broad canal, 3½ lines in length. In man, the vesicle always remains just outside the abdominal cavity in the chord, and becomes more distant as the chord grows. In oviparous animals, as soon as the vesicle around the yelk is completed, it ceases to grow; but in mammalia it continues to grow, and acquires a dimension of 6 lines in man. After the intestine is formed, the vitello-intestinal opening is closed and the tube obliterated, and the contents of the vesicle can be only absorbed by the omphalo-mesenteric veins, which continue to the third month, and be carried to the vena portæ and cava inferior. In birds, these changes do not occur till after hatching; because, previously to this, the yelk is not consumed and a way into the intestine must be left for it. In mammalia, the canal is obliterated about the fifth week, according to Velpeau. The canal narrows and closes at first nearest the intestine; and at length the tube becomes a mere filament, and then disappears altogether. The umbilical vesicle loses its fluid and disappears in man after the second or third month.

The two extremities of the alimentary canal are formed the first, and are originally closed. But the walls grow thin and are absorbed at the ends, and thus the mouth and anus are produced. Meckel saw a mouth open at three points only, the rest of the membrane being entire. The mouth forms in the sixth week,—a week earlier than the anus. The anus is at first immediately behind the genitals; and, towards the twelfth week, it is a slit separate from these by the perinæum. The integuments of the body harmonise by opening at the same time. The margins of the openings are, for some time, distant from each other.

The intestine grows so much in length, that it is, for a time, longer, proportionally, than in the adult. As the abdomen is too short for it, convolutions are produced; and, as it is the middle portion which outstrips the growth of the spine, this does not, like the pharynx, œsophagus, and end of the rectum, retain its original situation, but leaves the spine, and, till the abdomen has grown large enough for it, is partly contained in the chord. At first the walls are homogeneous; but gradually, though at a very early period, divide into a mucous and muscular coat, between which a layer of cellular membrane is developed. Valentin asserts that, in brute mammalia, the first inner coat is a sort of epithelium, softens, and is rejected, leaving the villi now in sight; and that these are nearly as large at first as they are subsequently, though set more closely together, and seen every where. After the third month he adds that in the large intestine they become less elevated; in the fourth, less conical and numerous; till, at the eighth month, there exist slightly elevated and serrated longitudinal folds only. Traces of the valvulæ conniventes are not discernible till towards the seventh month.

Like all other serous membranes, the peritoneum lies as a gelatinous plaster on the organs and parietes; is at first thick and soft, and gradually becomes thin and firm. It appears to grow from the spine forwards, on each side, till it reaches the median line, where it closes, as all serous membranes do.

Contractions take place in certain parts, — the seat of the pylorus and ilio-cæcal valve, dividing the canal into an oral, a middle, and an anal portion,—stomach, small and large intestines: dilatations take place in others, so that we have the pharynx, stomach, and cæcum. The small intestine is produced the last, and, from its situation, is the longest united with the umbilical vesicle; and it is united nearly at its middle in vertebrate animals, though in mammalia rather nearer to the large intestine. The small intestine is at first as broad as the large; it afterwards has even greater dimensions; and ultimately grows narrower. It is at first shorter, proportionally to the large intestine. The large intestine is at first proportionally longer and broader than the small. Its developement proceeds from the lower to the higher portions: except that the cæcum begins as a tubercle at the junction of the colon and ilium in the seventh week, while the beginning of the large intestine is still in the chord; that the ilio-cæcal valve appears in the third month also, while, at the fourth month, the rectum is distinguishable from the colon by its greater capacity only, and at the fifth by the sigmoid flexure of the colon, and in the seventh month by only the constriction which separates the cæcum from the colon.

The appendix vermiformis appears about the tenth week, nearly as large as the small intestine, and proportionally longer than in the adult. In the fourth week, it grows narrow and convoluted, and afterwards shortens. About the end of the third month, a large quantity of mucous fluid, clear, acid, and destitute of albumen, is found in the stomach. In the upper portion of the small intestine, and in the choledochus, a chymous-looking pap, consisting of albumen; and meconium of a greenish brown is afterwards found in the small intestines, but not till after the fifth month. The meconium becomes darker, and at last accumulates in the rectum. Thus, in the fœtus, its own secretions are digested, and partly decomposed and absorbed.

The large blind extremity of the stomach, the cæcum, and appendix vermiformis are so many great local growths of the alimentary canal. The salivary glands, pancreas, and liver are produced in the same ovary; but the elongation, in these cases, divides into a large number of branches, supplied with blood-vessels and nerves, and all united into a mass by cellular membrane. The pyloric appendages of fish, and the salivary and biliary vessels of insects, are, in truth, simple bare tubes thus produced, and not divided into branches. The salivary glands and pancreas spring from a little mass at the outer side of the alimentary canal, in which one or two tubes communicating together, small, and somewhat dilated at their extremity, are seen. These canals divide laterally into branches, each of which has also a somewhat dilated extremity; and this ultimately grows into a vesicle, and becomes milk-white, while the rest of the tube remains translucent like opal. In the mean time, the branch elongates, sends forth others, and these, again, others, till we have a tree, with vesicular dilatations of the extremities of its branches. The quantity of primordial substance which is converted into these continues to increase; and saliva is found in the vesicular extremities. Valentin has observed that the formation of the gland is accelerated by the production of firm bands at some distance from the principal tube, which grow towards it, unite with it, become hollow, and subdivide like the others.

The formation of the liver is too early and rapid for us to have hitherto observed it in mammalia; but in other animals it has been seen as two separate prolongations of the intestine, which in certain kinds unite perfectly, so that the two orifices become one. On this account, the left lobe of the human liver is long, nearly as large as the right, and the fissure in the median line. As the ramifications multiply and are enveloped in primordial matter, many lobules are observed at first, which afterwards mingle. The blood-vessels multiply. The substance at the third month is a greyish pap; afterwards firmer, granular, and of a dark red, more charged with blood than after birth, from receiving till then a large quantity of the blood of the umbilical vein. The organ soon becomes proportionally enormous, and gradually lessens again. Its weight is to that of the rest of the body, at the end of the first month, as 1 to 3; at the full time, as 1 to 18; whereas in the adult it is as 1 to 36. In the first month, it occupies the lower half of the trunk, as the heart does the upper: at the second month, it extends to the ilia; at the third month, the left lobe does not extend so low; and in the fourth, not so much to the left side. These changes arise from the diminished growth of the organ, first in the left lobe, and afterwards in the right, especially after the fifth month; the alteration of its position from the perpendicular to the horizontal; and the enlargement of the capacity of the abdomen.

The gall-bladder is a mere dilated extremity of a branch of the bile-duct, is formed the last, and is sometimes absent when the liver is perfectly developed. Its late formation causes it to remain outside the liver, and to dilate very slowly; and the biliary duct, not being surrounded by primitive matter, does not subdivide. It is an empty canal in the second and third month, and is almost cylindrical during the whole of fœtal life; after the fourth month it contains mucus, and in the seventh only does it admit bile, though this had begun to flow into the intestine after the fourth month. The orifices of the ducts of the pancreas and liver are originally distinct.

The lungs are projections from the œsophagus. In brute mammalia, a short but broad canal, ending in a proportionally very small vesicle, is seen. This vesicle has a slight sinuosity at its back part, and is thus divided into two chambers, which do not communicate. These become lungs, and the canal which united them to the œsophagus is transformed into larynx and trachea. The bronchiæ are produced by the two chambers not growing so much where the trachea is continuous with them as in other parts. This small part afterwards elongates, a few puffy plaits are seen in the walls of the vesicle, which grow into hollow warts, and render the surface uneven. As these elongate, others spring from their sides, which at length acquire bulbous extremities. A quantity of primordial substance envelopes the whole of these subdivisions, unites them, furnishes a matrix for the innumerable blood-vessels, and at length becomes the cellular tissue of the lungs. For some time, this so unites all together that the two lungs appear to be one mass. The lungs are originally situated above the heart, at the lower part of the œsophagus: they then move backwards. For a long while, the pleuræ are not filled by them, and contain a good deal of serum, which lessens just before birth. The weight of the lungs to that of the rest of the body, during the ninth and tenth week, is as 1 to 25 or 27; during the tweifth, as 1 to 43; at the tenth month, as 1 to 75. They are at first proportionally heavier, and subsequently lighter, than in the adult, because they grow more spongy, and they receive less blood than after birth.

The trachea is at first firmly attached to the œsophagus. Its branches become absolutely and relatively longer; its cavity augments; its walls grow firmer and thinner. It divides into two layers, the internal of which becomes the mucous coat, and cartilaginous rings are developed in the external. These, at first, cannot be separated. The external condenses into a series of small transverse striæ, which lengthen laterally till they touch at the back. The gelatine condenses more and more, till the striæ become cartilage, and the intervening portion is converted to fibrous membrane. The internal coat becomes less connected with the external, and for some time forms a cylinder which may be drawn out of the external: it then acquires the character of mucous membrane, and is again intimately united with the external coat. The branches of the trachea are at first very short proportionally to their trunk: cartilage forms in them much later than in the trachea. The larynx is originally much broader and thicker than the trachea; but soon lessens in both respects. It is at first nearly spherical, and for a long time a homogeneous jelly. The rudiments of the thyreoid appear in the seventh week: and then those of the cricoid, from two lateral germs. They are two irregularly rounded plates in the case of the thyreoid, which gradually approach each other at their lower edges till they unite in the fourth month: the angles of the cartilage elongate at the same time into horns. They are short narrow plates in the case of the cricoid, and unite later than those of the thyreoid. The arytenoid cartilages do not appear till the two others have acquired a considerable developement. Two long swellings next appear on the sides of the larynx, in which the upper halves of the arytenoids and the ligaments of the glottis form. Before it becomes cartilaginous, the walls of the larynx are thick, and its cavity augments slowly. The epiglottis does not exist at first, and the glottis is perfectly open.

The upper part of the mucous layer, having become tubular, represents a single blind cavity, below the front of the cranium, and afterwards divides, by the formation of the palate, into a *nasal* and *buccal cavity*. The mucous membrane splits, and the anterior parietes open, so that these cavities open externally.

The vestiges of the *nostrils* appear as rounded depressions, at some distance from each other, in the fifth week: they open in the latter part of the second month; at the same time the nose rises above them, and the nasal begins to separate from the buccal cavity. In the third month, the nostrils are closed with a membranous plug, which disappears about the fifth month. The *mouth* appears in the sixth week, as a slit almost from ear to ear, without lips, which begin to be distinguishable in the third month, and afterwards enlarge, the lower later than the upper, close the mouth, whose slit is now proportionally smaller, and open again in the sixth month.

In the seventh week, the *tongue* proceeds from the mucous membrane at the base of the mouth, and is a merely granular substance: at the beginning of the third month, it is very voluminous and flat, and projects from the mouth: at four months, it enters the mouth again, becomes thicker, and acquires papillæ, which are then proportionally larger than afterwards. At the upper part of the buccal canal, two projections of the membrane take place, which unite in the median line and lengthen backwards to form the velum of the palate.

The formation of the *teeth* begins with the third month, in the loose tissue of the jaws, by a series of whitish vesicles, placed side by side, and separated by a spongy structure. At the middle period of fœtal existence, fibrous partitions are seen between them, which ossify into alveolæ. These vesicles are covered by the cartilage of the gums at the alveolar border of the jaw, and at their other extremity receive vessels and nerves. Purkinje declares them not to be fibrous, nor to be converted into the periosteum of the alveolæ, but to consist of soft fibres and a granular parenchyma, with a vascular network and abundant nerves, and to be only united with the periosteum : their internal surface is smooth, like serous membrane. Within them, towards the end of the third month, at their lower part, a soft greyish substance, which is at first purely granular and covered by a simple transparent membrane, but afterwards receives vessels and nerves, and is the dental pulp, grows up ; and between this germ and the vesicle lies the organ of the enamel, — an almost globular nucleus, of granular substance, which subsequently is mingled with angular corpuscles united by cellular tissue. A limpid fluid is observed between the germ and the organ of the enamel and between this and the vesicle, containing mucus, albumen, phosphate of lime, hydro-chlorates, and sulphates, and a free acid, which is ultimately replaced by an alcali. The quantity of phosphate of lime continually increases, whereas the fluid diminishes and at length ceases altogether. As the germ increases, it penetrates the organ of the enamel, which at length becomes merely a fine envelope, and produces, on its internal surface, the membrane of the enamel, consisting of a layer of perpendicular fibres. Ossification begins in the fourth or fifth month by layers deposited on the dental germ, from without inwards, and at the summit first, and extending to the roots. At this time, the germ shrinks. According to Purkinje, the dental substance consists of canals bent repeatedly on themselves, hollow as long as they do not lengthen by fresh deposits, and at last filled with a peculiar yellowish substance. He states, likewise, that, when ossification begins, enamel becomes deposited in perpendicular fibres, from within outwards, neither brilliant nor so hard as it is afterwards. Each tooth is formed at the same time with its fellow on the other side. As the lower jaw has a little the start of the upper, its partitions and teeth are the first developed. At first, the teeth appear in the order of their proximity to the median line ; afterwards, in the order of their size. For the first, or milk teeth, there are 16 vesicles in the third month ; 8 for the incisors, and 8 for the anterior molars ; and, at the beginning of the fourth month, 4 for the canine. Ossification begins at the fifth month, first in the internal incisor, then in the external ; next in the anterior molar, the canine, and second molar. The nerves and vessels enter them by a particular canal, situated below the permanent canal. Other branches, connected with the preceding, determine the production of the second set of teeth, the rudiments of which form while the first set is developing. Their vesicles grow at the back of the first fibrous vesicles; and, when they are as large as a pin's head, they rest immediately upon the latter, without their cavities communicating. As they grow, they become distant from them, though still connected by a filament, and plunge more deeply into the jaw. Gradually, osseous matter is deposited between the two sets, and converted into a canal above that of the first set. Partitions also are developed between them. At the tenth month, the crowns of the incisors are complete, and the roots of the inner incisors begin; a third only of the crown of the canine is seen; the upper part of that of the first molar, with its points, is formed; the four points of the crown of the second molar are not yet united; ossification has in general begun in the crown of the third molar of the second set, but the others are still vesicles, nor all of them, perhaps, supplied with germ.

THE VASCULAR LAYER.—The vascular layer, which adheres more strongly to the serous than to the mucous layer, perhaps because formed from the latter and attracted to the other, is distinguished by its large and perfectly transparent granulations, so compacted as to be flattened at many points. The basis of the vascular system begins at two separate points; at the extreme surface,—the coverings of the ovum, which are the most transitory part (the sanguineous circle); and at the most internal,—the commencement of the cavity of the body formed by the case of the heart, which is the most permanent part. In the chick the sanguineous circle begins at the sixteenth or twentieth hour—a few hours before the heart, though without containing any liquid blood,—and the heart about the twenty-seventh hour;—both being still a merely primordial mass. A harmony exists between the two parts; for the heart has, from the very first, crura, to receive the veins of the umbilical vesicle, and these veins, from the first, run inwards to unite with the heart. Neither the heart nor arteries are at even the very first found empty. They and contents appear to originate simultaneously.

Between the twentieth and thirty-sixth hour, the sanguineous circle is formed; then the heart; and immediately blood appears, but motionless. The heart is whitish, transparent, and still. After the heart has divided into walls and fluid contents, it begins, in the middle of the second day, in ten hours from its origin, to undulate, but neither receives nor expels blood, simply agitating its colourless fluid, while a little red blood is already formed in the sanguineous circle. After the middle of the second day, the heart receives and expels, but there is no circulation.[n] The heart, by the dilatation of its crura, seems to attract the fluid formed in the sanguineous circle: for a colourless current begins in the central part of the membrana proligera, and not till after this a red current in the peripheral part,—the sanguineous circle. Omphalo-mesenteric veins form without arteries, and aortæ without venæ cavæ. At the end of the second day, or the beginning of the third, there is a simple circulation, — the blood flows from the veins of the umbilical vesicle to the heart, and thence into the aorta; and from the aorta through the arteries of the umbilical vesicle into the sanguineous circle. Between the third and sixth day, the aorta and venæ cavæ ramify, so that a circulation is established in the embryo itself, in addition to that between it and the sanguineous circle: the aorta ramifies on the branchial arches, and the vena portæ in the liver.

The branchial vessels then disappear, the circulation of the umbilical vesicle declines, and a second external circulation is established with the allantoid. At length the blood streams less to the allantoid and more proportionally towards the lungs, for the commencement of a second internal circulation.

The *heart* is an oblong body, which becomes a sac by the liquefaction of its axis. The upper part becomes arterial; the lower, venous. The walls of the arterial portion soon acquire thickness and the rudiments of muscular structure; but those of the venous remain thin. The arterial portion divides into arterial ventricle and aortic bulb; the venous into two segments merely, —the one dilated, the other, which is the venous trunk, rather narrower. The organ elongates, and divides by two constrictions; one between the venous sac and the arterial ventricle, and the narrowed portion is called auricular canal; the other, between the arterial ventricle and the aortic bulb. The former afterwards, probably, retires into the ventricle, and becomes the auriculo-ventricular valve: the aortic bulb enters the substance of the heart and becomes a portion of the two future ventricles, exactly as the venous trunk becomes two auricles. The heart is next divided longitudinally by constriction, from below upwards; and, till the fifth month, a depression is visible externally. The ventricle is therefore the first divided; but a large opening exists up to the seventh week, which is obliterated after the second month. The heart, at six weeks, has the same breadth as length; but, when the ventricular septum begins, it becomes more pointed and conical. It is at first proportionally larger than in the adult, and situated vertically. The right ventricle is at first smaller in every direction than the left: but equals it in length at the sixth month. The division of the auricles does not begin till about the end of the second month, and at first leaves an opening, called foramen ovale. The left auricle is at first smaller than the right, but grows in the third month. The lining membrane of the inferior cava is continuous with that of the auricles, and forms two folds, — the valve of the foramen ovale, and the valve of Eustachius. The right side of the heart is at first much larger than the left, and does not begin to diminish before the middle of embryonic life. The pericardium appears in the ninth week.

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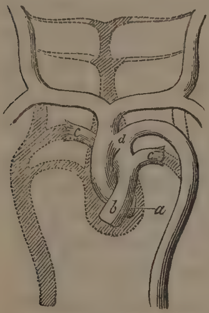
[n] "About the fourth week, the motion of the heart has, under favourable circumstances, been observable in the human embryo, and even commonly been denominated the *punctum saliens*, from the days of Aristotle, who observed it in the incubated egg." "Aristotle, *Hist. Animal.* I. vi. c. 3. *Opera*, vol. ii. p. 326."

In the chick, the first vessels are the veins of the umbilical vesicle; they spring from the primordial part of the vascular system,—the sanguineous circle, which is an annular portion of blood on the umbilical vesicle, without walls; and it is soon converted into a vein (terminal sinus, or vein, or venous circle), and then disappears. The first blood is said to be a limpid serosity, which grows yellow, acquires a few spherical red globules that afterwards, by their multiplication, give the whole fluid a red colour, and become ultimately flat and oblong in the three lower classes of vertebrated animals, in which, also, they are larger during the fœtal than the adult state. The blood originates from a primordial organic granular mass placed between the serous and mucous layer, and derived probably from the yelk, since it strongly resembles this, though a change must have been undergone, because it is colourless and contains no oil. Its passage through the mucous layer gives a probability that the mucous layer has both drawn it through and changed it. Sanguification is thus preceded by another process, just as it is after birth by chilification. Blood has also appeared in the midst of the solids, where it could not have reached them from another part. Doellinger saw a portion of the primordial mass of a fish liquefy, and divide itself into a venous and an arterial current. Haller saw first veins, then arteries, appear in the cerebral vessels; and, in the limbs, first red points, then continuous red lines, and at length coherent blood-vessels. Baer thought he perceived in the villosities of the fœtal placenta blood not contained in walls, and therefore formed at the spot. The granular mass thus liquefies, and changes into *blood*, and *vessels* form about the blood.

Thus blood is first formed in the umbilical vesicle, and is taken up by the omphalo-mesenteric vessels; then it is formed in the embryo, out of materials absorbed by the flocculi of the chorion from the amniotic fluid, which has penetrated from the uterus, and by the umbilical veins from the fluids of the maternal part of the placenta. The venous circle either does not exist, or vanishes very early, in nearly all mammalia. The omphalo-mesenteric veins are soon joined by the corresponding arteries, which, being the first branches of the aorta, arise from the embryo, and become continuous with the veins. In mammal brutes, there are but one artery and vein: the latter is larger than the artery. The vein receives the mesenteric vein, and then opens into the trunk of two veins called Cuvier's ducts, which run to the jugulars. It, at an early period, gives to the liver a posterior branch, which is a branch of the vena portæ, and receives an anterior branch,—the hepatic veins. Afterwards, the vessels of the umbilical vesicle perish, and the mesenteric only remain, which gradually lessen till they are but a subordinate part of the digestive system. To the simple circulation of the umbilical vesicle is soon added the first internal circulation, the aorta ramifying into the different organs of the embryo, whence arise the roots of the vena cava; but the formation of the arteries is determined by the cervical branchiæ in a perfectly uniform manner in all vertebrata, permanent in fish, transitory in the higher kinds. The branchial arteries are five in number, and form so many pairs of arches. In the second month, two arterial trunks are seen. The superior (*a*) arises from the left ventricle, and ramifies to the head, arms, and upper part of the body: it is the ascending aorta, and probably the trunk of the third vascular arch, and of the branches of all the three highest arches. The lower trunk (*b*) arises from the right ventricle, and goes in an arched form to the lower part of the body: it is the descending aorta, and the remaining portion of the fourth and fifth lower arches. The two trunks are united by a slender anastomosing branch, — the remains of the root of the aorta that formerly extended from the anterior vascular arches to the posterior. In the eighth week, the lower arterial trunk, towards the middle of its course between the heart and the insertion of the anastomotic branch, begins to furnish branches (*c c*) to the lungs, which are then developed, and the rest of its extent, from the pulmonary branches to the anastomosing branch, has the name of canalis arteriosus (*d*). Gradually, the pulmonary branches increase, and receive a larger quantity of blood laterally, the current diminishes in the canalis arteriosus, and this canal itself diminishes; but the anastomosing branch increases in the same proportion, the descending aorta receiving more blood from the superior trunk. Thus the lower arterial trunk becomes the pulmonary artery, its transition into descending aorta becomes an anastomosing branch — the canalis arteriosus, which is obliterated after birth, but the primordial anastomosing branch becomes the arch of the aorta, that is, the intermediate portion between the ascending and descending aorta.



View of the vessels of a bird in the last third of embryonic existence.

The remaining vessels are represented fully figured: the transitory are merely shaded. The shaded pyriform bag is the single aortic bulb that afterwards divides into the two arterial trunks of aorta and pulmonary artery. — (*Baer.*)

In the third period, while the internal circulation becomes more or less obliterated, an external takes place. The two iliac arteries, produced by the division of the descending aorta at its lower end, leave the abdomen of the embryo under the name of umbilical arteries, and spread on the surface of the ovum, forming the vascular membrane, termed endochorion. The blood streams from the right ventricle into the descending aorta, consequently into the lower half of the body and the endochorion, whence it returns by the inferior cava into the left auricle; from this it flows into the ascending aorta and the upper half of the body, and is brought back by the superior cava into the right ventricle. In fact, the blood of the inferior cava is driven principally into the left auricle; first, because this vessel extends more to the left than to the right in the venous sac which as yet is not divided, and consequently is directed still more to the left auricle when the septum is formed; then because the valve of Eustachius prevents the blood from running from the inferior cava into the right ventricle, and directs it towards the foramen ovale, and consequently towards the left auricle; lastly, because when the apex of the heart turns to the left in the fourth month, the foramen ovale is directed more forwards, so that it is placed opposite the inferior cava. Besides, the valve of the foramen ovale is pushed into the left auricle by the blood of the right, so that the foramen opens wider, while a pressure from the left auricle applies the valve to the sides of the foramen and closes it. The blood of the superior cava runs straight from the right auricle, along the valve of Eustachius, into the right ventricle. If two differently coloured injections, even, are passed simultaneously through the cavæ towards the heart of a fœtus not of full time, that which is transmitted through the inferior is found in the left half of the heart and the ascending aorta; that from the superior goes entirely to the right ventricle, pulmonary artery, and descending aorta. Towards the end of fœtal life, the foramen ovale grows smaller, and the orifice of the inferior cava more distant from it; consequently, the blood flows into the left auricle only when the right is filled up to the two sides of the Eustachian valve. The pulmonary vessels become more developed, so that less blood passes from the pulmonary artery to the aorta; the canalis arteriosus becomes proportionally narrower; the left auricle receives more blood from the pulmonary veins; and all these changes gradually prepare for the metamorphosis which the circulation undergoes at birth.

The *respiratory organs* are productions of the mucous layer, or external protrusions of the intestinal canal, united with corresponding productions of the vascular layer. For some time they are near the surface of the body, but become deep-seated by degrees. Parallel slits exist in the neck of man and all other mammalia, as well as of fish and batrachians, leading into the cavity of the throat: they begin soon after the formation of the heart, about the fifth or sixth week, before the lungs, allantoid, or placenta: at first there are mere grooves, and these grooves deepen till they become slits and penetrate into the guttural cavity. At each branchial arch, that is, at each band of granular substance between two slits, there arrives a branch of the aorta, running from before to the posterior end of the band; and afterwards uniting with the analogous branches of the other branchial arches of the same side, to produce a root of the aorta. From being perfectly bare, the branchiæ gradually become more or less covered by a crop of granular matter, which proceeds from the head towards the trunk, or by a trace of copercle consisting of skin itself. In fish and batrachians, this formation proceeds further; in higher animals it stops here, the branchiæ disappear and the slits close after an existence of a few days.

There are likewise abdominal branchiæ situated at the anal extremity of the alimentary canal. In some invertebrate animals they are the only organs of respiration, and continue throughout life; in some insects they are temporary, and exist during the larval state only. In fish and batrachians, as the cervical branchiæ are such predominant parts, they do not exist. In superior reptiles, birds, and mammalia, they appear as soon as the cervical branchiæ disappear. Their basis is a prolongation of the anal extremity of the digestive canal, in the form of a vesicle, or the allantoid, on the outer surface of which the terminal branches of the descending aorta, or the iliacs, spread and form a special vascular layer,—the endochorion, which surrounds the fœtus, performs the office of lungs that are not yet in operation, and is got rid of by the fœtus as soon as birth takes place. The allantoid begins sooner than the chord, properly so called,—the product of the omphalo-iliac vessels, but later than the beginning of the intestines, than the heart, liver, and Wolffian bodies. It appears in the third and fourth week, and lasts till about the end of the second month; but in brute mammalia it is found at birth, though its full growth is attained early. It grows rapidly, but remains always very inconsiderable. It lies between the chorion and amnion, or rather within the vascular vesicle called endochorion, which covers the one and lines the other. The tubular portion of the allantoid extends at an angle towards the abdomen, and becomes the cloaca, and at length the urinary bladder. Like the tubular portion of the umbilical vesicle, it is at first very short, so that the allantoid is applied immediately to the abdomen; and it grows in proportion as the allantoid becomes more distant from the embryo by the elongation of the umbilical vessels. The urinary bladder and urachus are the remains of the allantoid. The former is originally the portion which opens directly into the cloaca. When the cloaca becomes inverted and is an external surface, the rectum and bladder acquire each a separate orifice, and so become distinct organs. In lizards, the tubular portion of the allantoid, about the middle of its length, below the rectum, has been seen to dilate into a vesicle, and afterwards grow narrow to end in the cloaca, and thus was seen in course of separation from the alimentary canal and conversion into urinary bladder, which, in man, begins as a canal, and the narrow and elongated shape of which, in the subsequent months, appears to show its origin from the allantoid tube. The urachus is the portion of the tube nearest to the allantoid, and its obliteration proceeds from the allantoid towards the urinary bladder. The younger the embryo, the larger the urachus. After the fourth month, it is pervious to the distance of only a few lines from the bladder, is solid near the umbilicus, becomes a slender filament in the chord, and ends in mere cellular membrane.

The bifurcated extremity of the aorta extends upon the allantoid, and gives off the umbilical, or omphalo-iliac, arteries, which cease to be trunks after birth and become mere secondary branches of the hypogastric artery. They run outside the allantoid and its developements, consequently on each side of the bladder and urachus; reach the umbilicus, pass into the umbilical sheath, united by cellular tissue into a membrane, which is the endochorion, and ramify towards the surface of the ovum. The outside of the endochorion is in contact with the other membrane, termed exochorion.

These ultimate ramifications here become continuous with the umbilical vein, which accompanies the arteries in the umbilical sheath, but quits them at the umbilicus, ascends between the abdominal muscles and peritoneum, runs along the fold of the latter, called suspensory ligament of the liver, and, after sending off several twigs, especially to the left lobe, ultimately divides into two branches,— one of which joins the left root of the vena portæ, while the other, under the name of ductus venosus, or venous canal of Botallus, Arantius, or Glisson, ends in the vena cava inferior, near the origin of the hepatic veins.

After the third month, as the umbilical vesicle now has disappeared, and the allantoid disappeared at the end of the second, the umbilical vessels only remain in the chord.[o] This at first does not exist, and is very short even at the sixth week, and in a straight line with the body, as long as the umbilical arteries extend in the same direction. The *chord* is developed about the period of the developement of the placenta, becomes opake in about the ninth week through the deposit of a granular substance, grows thin, elongates, and in the tenth week is longer than the embryo. The vessels give off no branches in it. The vein is thinner, more capacious, and shorter than the arteries; and it occupies the centre. In the tenth week, the vessels begin to be twisted spirally, and the spiral turns gradually increase, are more numerous in the arteries than in the veins, and, in most, run from left to right, if the chord is viewed as hanging from the abdomen. Within its covering from the amnion, the chord has another tubular membrane from the endochorion or internal and vascular portion of the chorion.

In birds and the superior reptiles, the vessels of the endochorion stop at the allantoid under the testaceous covering, because they exhale and absorb a gaseous fluid only that easily traverses the membranes. In mammalia, they reach the external surface of the testaceous membrane, or exochorion, because liquids are absorbed, and they form projections, surrounded by prolongations of the exochorion and constituting special organs. The lowest form is a network on the whole surface of the chorion, as in solipeds and swine: the next is seen in ruminants, in which the vessels, arranged in a network with large meshes, produce from 50 to 100 round or reniform disks, called *cotyledons*. In the highest degree, these cotyledons are all united in one at the end of the chord, and this one is the fœtal *placenta*. In rodentia, it has several lobes; in carnivora, it is flat and annular; but in man, has the highest form. The placenta originates in all animals from the omphalo-iliac vessels. All the surface of the exochorion has villosities at the end of the first and during the second month: towards the end of the second, the umbilical vessels penetrate into those villosities which are situated where the decidua is reflected: at the third month these villosities are vascular sheaths, and become united by means of cellular membrane.

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[o] Mr. John Miller, quoted *suprà*, p. 798., stated that he dissected 127 human abortions and fœtuses, and made a preparation showing the omphalo-mesenteric vessels and umbilical vesicle at nine months; as well as one showing the germinal disc, and another the first formation of the amnion and allantoid: and that he made a brute preparation demonstrating these two membranes to be one, so that the fluid of both is the same. (*Lancet*, Nov. 18. 1837, where he gives an engraving of the early ovum, the original membrane becoming twisted into an hour-glass form and thus converted into two — the allantoid and amnion, and the twist in the centre becoming the urachus.)

The uterus produces a vascular congeries, or maternal placenta, which meets and unites with the fœtal placenta, having elevations and depressions corresponding with others in the fœtal placenta, so that they become set in each other, except at the centre. This takes place opposite the reflexion of the decidua, usually where the uterus is most soft and vascular, and therefore most endowed with vital energy, — at the opening of one of the Fallopian tubes, or between them, — where only the ovum, by its chorion, is in contact with the decidua crassa, having plunged from the Fallopian tube into the decidua, and pushed this before it to form the reflexa. Towards the end of the second month, a fibrinous secretion is poured forth, as Wrisberg and Lobstein especially have demonstrated, in cases at least in which the openings of the Fallopian tubes were blocked up with fibrin; and this secretion, (see *suprà*, pp. 786. sq. 799.) coagulating in the form of a disc, forms a cover to the little pit of the decidua in which the ovum lies, and is the rudiment of the maternal placenta. This last-formed portion of the decidua has been termed the secondary decidua. In the third month, large uterine vessels extend into it, ending in cells, or great dilatations, from which veins spring.[p] In the fourth or fifth month, the uterine placenta becomes cellular and unequal, plunges into the fœtal placenta, and receives the lobules of the fœtal placenta into itself, from which it may be readily separated by maceration; but the union becomes subsequently firm. It obtains a thickness of 4 lines; and before the completion of utero-gestation is reduced to an insignificant, thin, and perhaps gelatinous, plaster. After the ninth month, receiving less blood, the fœtal portion becomes smaller in proportion to the fœtus; and some of its vessels turn to fibres, easily mistaken for nerves or lymphatics. It becomes lacerable and flabby, and its connections with the womb loose. The maternal portion of the placenta is not only formed later, but is much less considerable than the fœtal.

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[p] Mr. Miller threw injection of one colour into the maternal hypogastric artery and vein, and of another into the child's umbilical arteries, and found an artery as large as a crow quill to pass from the uterus into the placenta, and the decidual vein to run around the margin of the placenta. In this vein he always saw at least three, and sometimes four, openings, as large as goose quills,

Certain vascular organs do not, like those already mentioned, belong to the surface and form fluid by the operation of the exterior, but are internal conglomerations of vessels, unconnected with the surface, and blood forms in them by the operation of the substance of the body itself.

The *supra-renal capsules* are first a single mass, which lies on the spine, and at length divides into two. They are much larger than in after life; larger than the kidneys after the fourth week; equal to them in the fourth month; smaller than they in the sixth month, at which time their weight, compared with that of the kidneys, is as 1 to 2·5, and in the fourth month, as 1 to 3; whereas in the adult, it is as 1 to 2·8.

The *spleen* forms in the tenth week, as a very small body pointed at its two extremities, and divided into many lobules between the two layers of a fold of mesentery. It gradually becomes reddish, and lies more forward than after birth; but remains much smaller, relatively, than in the adult.

The *thymus* is in two distinct masses in the tenth week, on each side of the trachea; and these afterwards unite from below upwards, increasing so rapidly that they equal the lungs in size for some time and become proportionally larger than after birth.

The *thyreoid* appears at the same time with the rings of the trachea. It consists, originally, of two separate lateral halves,

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leading into the uterine veins, and through which all the blood of the maternal placenta returns to the uterus. He observed also another set of vessels called decidual arteries and veins, and by Dr. W. Hunter curling vessels, running on farther than the uterine layer of the decidua. (*Lancet*, ib.)

which unite in the fourth month. It is proportionally larger and richer in blood than in the adult.

The *uro-genital* system arises from the organic mass originally deposited between the serous and mucous layers. It becomes connected both with these productions (the intestinal mucous membrane, mediately or immediately, and the surface), and with the vascular layer. The first formed are the *Wolffian bodies*, or false kidneys, secreting organs, with transverse secretory canals, and a longitudinal excretory duct which ends in the cloaca or uro-genital canal. They are covered with peritoneum, and, in higher animals, the kidneys form behind them, the plastic organs of generation before them, and the ducts of the latter to their outside. They are unconnected with any of them, precede them, and appear to be substitutes for them, especially for the urinary organs, in the early period of fœtal existence. The higher the species, the quicker their growth in proportion to the whole duration of the developement of the animal. In mammalia, they acquire their greatest dimensions long before the middle of fœtal life. After a time, as the whole body grows, they grow as much as before absolutely, but less relatively. Still later, they absolutely diminish, and at last disappear entirely ; so that, in mammalia, they are not found at birth. They have abundant blood-vessels, and, after their full growth, receive more blood than any other organ except the liver. They are true kidneys in structure and function; and, in the mammalia, secrete a thin limpid fluid. Their excretory ducts begin to diminish from before backwards, before the organs themselves are absolutely smaller, and disappear altogether before them.

The *kidneys* appear nearly at the same time with the internal sexual organs, on each side of the aorta, between the Wolffian bodies and the back, as two rounded bodies, composed of oblong sacs, converging to one side, and there continuous with the ureter. They become longer, and acquire the shape of a French bean. The sacs augment in length and number, become uriniferous tubes, and ramify. At length, cortical and tubular parts become distinct, on account of some tubes becoming tortuous and having a larger number than before of vessels ramifying among them, while the rest remain straight and have no additional supply of blood-vessels. Their surface is at first smooth ; but afterwards irregular, as if several pieces were united, on account of several uriniferous tubes becoming grouped together and raised upon the surface without a proportionate developement of cellular tissue to fill up the intervals ; but this appearance ceases from the spaces becoming filled up, at length, with cellular membrane and a farther developement of uriniferous tubes, as well as from a general condensation of the cellular membrane of the organ. Their blood-vessels are subordinate branches of those which originally belonged to the Wolffian bodies; and such subordinate branches are left for the kidneys only. At an early period, the Malpighian bodies, which are terminal branches of the arteries collected into little masses, are seen in the kidneys, both at their surface, as in the Wolffian bodies, and in their body, and increase greatly in number.

The *ureter* arises from one part only of the organ, soon grows capacious at its point of connection with the kidney; thus forming the pelvis: and, while extending gradually towards the bladder in one direction, it branches out in the other, and thus forms the calices. According to Valentin, the shape of the ureters and uriniferous tubes is visible in the primordial mass, and their interior liquefies independently, while their walls acquire more density : but they form independently the one of the other. The *urinary bladder* arises from the lowest part of the alimentary canal, — the anterior part of the parietes of which hollows itself out, and this more and more. It thus opens, originally, into the intestine. But at length the intestine divides into two halves: the one posterior is the external opening of the intestine only; the other anterior is for the discharge of the urinary or genital products only. The urethra is therefore open originally, and for some time immediately before the anus: it is very long, because the bladder is above the pelvis. The bladder is the portion of the allantoid between the urethra and urachus, and becomes permanent from its vascular and mucous layers retaining their vital energy. It is, therefore, originally a product of intestine and independent of the secreting urinary apparatus.

The *genital organs* are developed later in living systems in proportion as these are lower in the scale. In general, the genital organs do not appear in plants till full growth has arrived: in invertebrate animals, they do not appear while the embryo is in the shell: in birds and mammalia, they are found early in the ovum: in man, they appear earlier than in any other animal.

The *testis*, or *ovarium*, is situated to the inner side of the Wolffian body, held to it by peritoneum and vessels. At the seventh week it is a very long body. The testis is at first soft, greyish, and homogeneous; and seminiferous tubes gradually form in it. The ovarium is at first smooth; and acquires the appearance of a grape in the twelfth week, and loses it again in the fourth month. Both testes and ovaria are proportionally larger at first than subsequently. Both are situated before the kidneys, behind the peritoneum, which invests them, except at the posterior part where the blood-vessels penetrate. The peritoneum, particularly in the male, plunges into the inguinal canal, and the testes and ovaria descend and become more distant from each other. The descent of the testes has already been fully described in Chapter XXIX. The median organs of generation, — the *Fallopian tubes* and *uterus*, and the vasa deferentia, form independently of the ovaria and testes, though in invertebrate animals and fish they are prolongations of them. They are at first straight filaments, of uniform diameter, which soon become hollow, and change to canals, extending at one extremity to the testes or ovaria and at the other to the organs of copulation. They are developed all along the external edge of the Wolffian bodies; are longer than the testes or ovaria; descend at their outer side; and unite above the pelvis into a common duct. The anterior extremity of the Fallopian tube elongates to a point, and, when the whole grows hollow, expands into a trumpet in the fourth month; and, at the eighth month, is more convoluted than in adult life.

Near the testes and ovaria, winding canals are developed towards the vas deferens or Fallopian tube, representing the epididymis and accessory ovaries. The latter are analogous to the epididymis, conical and flat bodies, with very fine canals, which never become continuous with the Fallopian tubes, — so soon do the bodies altogether disappear.

The dilatation of the vasa deferentia and Fallopian tubes into *vesiculæ seminales* and *uterus* takes place gradually. These conduits unite into one tube, which ends in the uro-genital canal. In the male, this tube shortens and enters the latter canal, so that the conduits have two orifices, and send forth each a process or hernia, which is the vesicula seminalis. In the female, they unite at an acute angle and form the uterus: and in the third month, their lower ends dilate a little, and produce the cornua of the uterus, which grow shorter and wider, unite at a less acute angle, and disappear at the end of the fourth month, so that a single cavity exists. The upper part of the uterus is consequently at first concave; but in the fifth month is straight; and in the sixth, convex. The neck is the first single part of the uterus which is formed, and developement advances upwards; and thus the neck is the thickest part at the fifth month. The womb is at first continuous with the vagina, and has no projection: afterwards, the external opening forms in it; and the vaginal portion grows so rapidly, that it is proportionally larger in every dimension than subsequently.

The *external genitals* are developed independently, but in harmony with the internal. In mammalia, the vas deferens and Fallopian tubes terminate, at first, each separately, in the cloaca, a little behind or on each side of the orifice of the allantoid. The cloaca, as was mentioned at page 901., afterwards divides between these two terminations which are then in the anterior of the two halves produced by the division, and to which the name uro-genital is given by Valentin. The vasa deferentia and Fallopian tubes open into the beginning of this canal, immediately below the original orifice of the allantoid. In the male, this state continues through life, and the uro-genital canal developes itself into the portion of the urethra situated between the orifices of the vasa deferentia and the symphysis pubis. In the female, a little process forms in the uro-genital canal, where the openings of the oviducts are originally placed, and which are now on the convexity of the process very near each other. Soon the excavation increases, and after some time represents an irregular conical cavity, which developes into vagina and neck of the womb. At the same time, the uro-genital canal grows much broader, and at last produces the vestibule. The urinary bladder becomes situated farther and farther from the uro-genital canal, with which it was before continuous; and between it and this canal a small tube is produced, generally termed the female urethra. The *hymen* appears in the fifth month, as a narrow fold.

The external projections appear later than the internal organs. The *external genital* organ is, in the sixth week, a small wart, fixed to the rudiments of the pubes, before the cloaca; and, in the seventh week, has a groove along all its lower part, leading above to an oblong aperture, which is the common orifice of the alimentary canal, urinary and genital organs, all united into a cloaca. The root of the penis is covered above and at its sides by a fold of skin from the abdomen, which fold is continuous below with the lips of the opening of the cloaca. These lips unite and form the *perinæum* at the end of the third month, while the anterior edge of the orifice of the allantoid grows at their union in the form of a fold, so that the cloaca is divided by a septum into rectum and urinary passage : the septum at length unites with the perinæum. When the perinæum is formed, the edge of the *anus* rises till it resembles a round perforated wart, which afterwards gradually sinks. Three different parts are early distinguishable in the penis, — viz. two symmetrical chords united at their inner side and placed on the convex portion of the organ ; and a smaller part on the concave portion, representing a gutter with thick walls, and separated from the other chords by two shallow lateral grooves, but a little thicker at its extremity, where it forms two lateral lobes. While the perinæum is forming, at the end of the third month, the genital organ acquires characteristic sexual differences. In its developement as a *clitoris,* the growth of its essential parts is arrested ; but the cutaneous fold at its root, continuous with the perinæum, augments in thickness and length, especially at its sides, outstrips the clitoris, covers it and becomes the labia. In its developement as a *penis,* the edges of the gutter and the sides of the cutaneous fold unite, from the root to the extremity, and thus a canal is formed. The cutaneous fold grows till it envelopes the whole organ. The lobes of the corpus spongiosum urethræ unite and form the glans. The penis grows at first faster than the clitoris, and afterwards becomes rather smaller than it.

As the cloacal slit is a cutaneous prolongation running to meet the digestive, urinary, and genital organs, and as the sebaceous glands are descents of the skin, and the glands of Meibomius prolonged sebaceous glands, so the *mammary glands*, originating from the skin, like the salivary from the mucous layer, are cutaneous descents, which ramify internally, as though attempting to make towards the genitals. As the skin rises into a conical body, — the genital organ, at the cloacal fissure, the nipples arise at the mammary glands, which, during the third month, are small elevations in the midst of large orifices.

It may be useful to see the course of all growth according to periods, as drawn up by Burdach.

He divides the period of fœtal life into seven stages.

1. The *first* comprehends the period at the end of the first fortnight, when the central organ of sensibility and its coverings are discernible, as the first parts having an appreciable form; and the amnion, which did not before exist, presently forms. This period is short, perhaps not longer than a day.

2. The *second* includes the third, fourth, and fifth weeks. The embryo acquires parietes, bounding it from the ovum; several single organs appear,— the intestine, umbilical vesicle, allantoid, and liver, the heart, the vascular trunks, and the branches which they send to the branchiæ and umbilical vessels; the sanguineous system, which is just produced, is very limited, and does not penetrate the whole mass; the branchial apertures, the allantoid, and the canal of the umbilical vesicle appear, but only to disappear presently.

The chorion, and therefore the entire ovum, becomes 10 or 15 lines in length: arborescent flocculi grow from it, and penetrate the decidua reflexa, adhering to it or the decidua crassa, so that the ovum becomes fixed.

The amnion, filled with clear fluid, is much smaller than the chorion, covers the back and extends to the sides only of the embryo, which thus lies as if in a pit, with its ventral surface bare; the amnion extends more and more forwards, till, at the point where it is continuous with the ovum, it produces a canal,— the umbilical sheath, which is at first short and broad.

The embryo becomes from 1 to 3 lines in length, and from 1 to 3 grains in weight; is semitransparent, gelatinous, and under the microscope granulated; and it soon is bent forwards.

The head is a round mass without apertures; though at first scarcely distinguishable from the trunk, it increases so rapidly, that in the fourth week it is as large as the trunk, from which it is divided in front by a slight transverse furrow only, — the rudiment of the neck, and behind by the angular projection occasioned by the sudden turn of the chorda oblongata. During the fourth week, the eyes appear as black points.

The trunk has no limbs, and ends in a point like a tail. The parietes, formed of granulated substance and transparent membrane, grow from the sides both backwards and forwards; in front they soon unite at the median line, producing the chest, and leaving a space at the abdomen only, whence the cavity of this remains continuous with that of the umbilical sheath. The vertebræ appear as cartilages, with rudiments of ribs like streaks, and but $\frac{2}{3}$ of a line long. On the ventral surface two vesicles are seen, continuous, by means of canals, with the mucous membrane of the abdominal cavity, horizontal at first, and ultimately vertical and encased in the umbilical sheath.

The first is the umbilical vesicle, globular, rather larger than the embryo, filled with limpid fluid, and having a very fine canal extending into it from the cephalic extremity of the embryo. The canal becomes continuous with the intestine where this makes a turn; but in the fifth week becomes obliterated at this point, and thus reduced to a filament. The intestine is short, uniformly cylindrical, and straight; passes from the stomach obliquely forwards into the umbilical sheath, turns upon itself at the insertion of the canal of the umbilical vesicle, re-enters the abdomen, and terminates in the anus.

The second vesicle is the allantoid, which disappears in man after the fourth or fifth week, but continues till birth in mammal brutes.

The urinary organs are not yet visible.

The heart lies horizontally, pointed forwards. The omphalo-mesenteric vessels — a branch of the aorta and a root of the cava, are full of red blood, and extend upon the umbilical vesicle. The omphalo-iliac vessels are of later formation.

The liver receives the greater part of the omphalo-mesenteric vein. It is of a reddish grey, very large, nearly half as heavy as the whole body, and divided into many lobes.

The branchial apertures, seen in transverse parallel folds at the sides of the neck, have branches of the aorta and vena cava at their edges, and are less distinct than in brutes; and they disappear at the end of the fifth week.

3. The *third* period extends to the end of the eighth week, and is marked by the lateral growth of the embryo, as well as by the greater projection of all its external parts, and its more complete distinction from the ovum. The brain and spinal chord, head, and spine grow broader; the peripheral parts, as the cartilages, bones, muscles, nerves, the external organs of sense, and the four extremities, are formed; openings take place in the intes-

tinal canal and organs of sense; the double organs of excretion appear,— the lungs, kidneys, and genital organs; as well as the cutaneous excrescences, eyelids, lips, ears, nose, penis, and clitoris.

The ovum is nearly elliptic. Its long diameter about 16 lines in the fifth week, and above 2 inches in the eighth; its transverse from 12 to 21 lines; its weight nearly 2 ounces. The flocculi of the chorion become larger and stronger at its upper and free part, as well as more subdivided and compacted together, than where it is in contact with the decidua reflexa; and their freer extremities float in the fluid secreted by the uterus. The amnion grows more rapidly than the chorion, its fluid increases, and the vesicula umbilicalis is full of fluid.

The embryo grows from 3 to 5 lines long in the fifth week; 7 in the sixth; 9 in the seventh; 12 in the eighth; and its weight exceeds a drachm. From having lain horizontally, with its abdomen upwards, it lies vertically, suspended by the umbilical chord, which is attached near the lower end of its trunk, and has now lengthened; the head, from its weight, being the lowest part.

The head is almost half as long as the body. At the end of this period, it becomes equal to scarcely one third. The spinal chord resembles a transparent canal full of whitish fluid; and the brain has a series of analogous vesicles. The substance, which condenses about the end of this period, forms, at first, the lateral anterior bands of the chord; so that this presents a groove posteriorly in its whole length, to nearly the tubercle of the os coccygis, which is covered by its membranes. The close vesicles of the brain are also developed the most laterally, and thus compelled to approach each other longitudinally: they open above by a longitudinal slit, and grow from below upwards and without inwards, or from the base towards the vault and from the sides towards the centre. The spinal chord grows longitudinally forwards from its flexure at the nucha, and another flexure carries it upwards. The cerebellum forms in the sixth or seventh week, and consists of fine narrow lateral laminæ, which grow towards the median line. The body of the cerebrum ascends before the cerebellum, and above the tentorium; and its corpora quadrigemina — two hollow hemispheres, raised at their sides, or not yet in contact at the median line, are the summit of the encephalon. The cerebrum bends downwards before the optic thalami, and there exhibits the corpora striata, covered by the hemispheres only, which proceed from their sides and have very thin walls.

The face begins to form, but is very small compared with the cranium. The eyes grow rapidly to a very great proportionate size, and, as the head grows in breadth, advance more forward: they are only a little above the mouth. At first, only a faint upper and lower line distinguish them from the rest of the surface; but towards the eighth week these lines become continuous folds — the rudiments of the eyelids, and the caruncle and opening of the nasal canal appear in the internal angle. The iris is a blackish ring, which forms in the seventh week, and is at first open within and above, and continues afterwards more narrow at this part.

The buccal cavity is a close vesicle below the brain, and comprises the nasal cavity. In the sixth week, it opens externally by a small slit, which is the mouth. This rapidly widens, so that at seven months it extends all across the face; and in the eighth week it is limited by cutaneous folds, which are the commencements of the lips. Gradually the nasal and buccal cavities separate; the palatine processes of the superior maxillary bone growing from before backwards and from without inwards, whilst between them the uvula grows downwards, divided at first into 2 lateral halves, which soon unite. The tongue appears in the seventh week, and is soon complete. The lower jaw consists of 2 lateral halves; is low, and has no branches.

The nostrils appear about the seventh week, as little depressions separated by a delicate septum, which opens gradually: towards the eighth week, the nose appears as a little swelling. In the sixth or seventh week the trunks of the meatus auditorii appear as little points: then the internal ear grows, at first like a flat projection, merely cutaneous, broad above, narrow below, in the midst of which the commencement of the auditory canal is seen as a longitudinal slit. The anterior edge bends and acquires a transverse slope, so that it separates into helix and antitragus. The frame of the tympanum forms, like cartilage, in the eighth week.

The heart and liver are seen through the walls of the trunk in front, the sides only being opake and one granular mass: but in the seventh week, the whole parietes become granular. Cartilaginification, beginning in the vertebral column, extends rapidly: the first points of ossification appear in the seventh week, at the clavicle and lower jaw; in the eighth, at the upper jaw and femur; and partly, also, at the squamous portion of the occipital and frontal. The fibrous membrane destined to become periosteum is sufficiently developed to be capable of detachment from the cartilages: the muscular structure is not very distinct. In the seventh week, the vertebræ are thick and broad, but still transparent; their bodies yellowish, and separated by transverse bands; the arches not yet complete. During the eighth week, the sternum appears, short and cartilaginous, in the walls of the chest: a cartilaginous mass at the sides of the lower part of the spine is the commencement of the pelvis. The extremity of the spine is a protuberance, slightly curved, which is the rudiment of the os coccygis.

The extremities, and first the upper, appear as globular tubercles, which at first grow from the trunk, and afterwards towards it. Soon the hand separates from the arm; then the division into upper and fore-arm takes place; then the hand divides into fingers, which are at first indentations, and then only tubercles at its edge: when the arm divides, the lower extremity divides into thigh and foot; and, when the fingers appear, it divides into thigh and leg. In the eighth week, the upper extremities are already 2½ lines long; the clavicle cartilaginous at its extremities only; the scapula scarcely discernible; the arm thick; the fore-arm very short; the hand longer, with 5 cartilages; each finger free, and the thumb discernible; the fore-arm begins to bend, and the hand to approach the chin. The lower extremities are about 2 lines long; without thighs, and projecting beyond the coccygeal tubercle only: they soon incline towards the abdomen, while the flexion of the knee is scarcely perceptible. The edge of the foot becomes indented; the toes gradually appear as coherent tubercles, and at last separate through their whole length.

The liver extends to the ilia; the gall-bladder is only a canal. The umbilical sheath narrows, and is 6 lines in length: the intestines begin to leave it in order to enter the abdomen; the small intestines form a few convolutions; the large intestines do not exceed them in thickness, and are behind them and straight, running downwards from the navel; the cæcum appears in the seventh week, as a small tubercle. The stomach is still perpendicular: its future upper side, constituting the right edge, is straight and continuous with the right edge of the œsophagus, and forms a straight line with the intestine; while the future lower side is to the left, and already convex. The great omentum begins. The anus is at first a mere depression, which opens in the seventh week.

The lungs and liver occupy the greater part of the trunk, and the diaphragm forms as a membranous expansion between them. In the sixth week, the breadth and length of the heart are equal: it is perpendicular, and divided into a venous sac and a ventricle. In the seventh week there are 2 ventricles, but communicating by a narrow oblong opening at the upper part of the septum, separated externally by a groove, and terminating in two points distant from each other. In the eighth week, the separation is complete, and the septum of the auricles begins. The heart at this time becomes horizontal. The vena cava is much larger than the aorta. At seven weeks, the aorta proceeds from both ventricles. The pulmonary artery sends branches to the lungs in the eighth week only.

At about the sixth week, the rudiment of larynx appears, soft and homogeneous. At seven weeks, it presents a cartilage with separate lateral parts. Below it is the rudiment of the thyreoid gland, with 2 small and separate lateral lobes. In the sixth week, the trachea is a slender filament; acquires cartilage in the eighth: the left bronchia is then larger, thicker, and denser than the right. The lungs are vesicular masses, which appear in the sixth week.

The Wolffian bodies reach from the heart to the end of the abdominal cavity, where their excretory duct opens externally. In the seventh week, the renal capsules appear in the epigastrium, the kidneys along the spine, and the formative organs of generation behind the peritoneum. The renal capsules are the largest. The testes and ovaria are perfectly similar, narrow, oblong, extending obliquely downwards and inwards. Their prolongations, —the vasa deferentia and Fallopian tubes have the same direction, and unite at an acute angle in a common canal of about the same diameter. The ureters unite similarly, to produce the urethra; and the bladder appears in the eighth week only, empty and shaped like an intestine. The anal opening receives the orifice of the genital and urinary organs. Before and above it, near the umbilicus, in the sixth week, the penis and clitoris appear as a conical body, at the lower surface of which a longitudinal groove forms in the seventh week.

4. In the *fourth* period, which is the third lunar month, the umbilical vesicle disappears; the placenta forms, by the production and union of the maternal and fœtal portions; the fœtus is completely enveloped, and acquires its permanent uterine figure. The chief organs exist, and accessory ones are produced. The solids have nearly acquired their shape; secretion is more abundant, as seen in the contents of the gall-bladder and intestines, in the fat and general fluid of the body. The thymus appears. The divisions of the alimentary canal are more distinct, and at its dilatation and extremities different plastic organs begin, — the salivary glands, spleen, pancreas, and cæcal appendix. The organs of sense close, by the union of their coverings or the formation of special tegumentary parts.

i. The ovum is about 3½ inches in diameter, and some ounces in weight. The chorion contracts an adhesion to the 2 deciduæ, and then loses its flocculi at these points: it unites by loose cellular tissue with the amnion; which, by growing rapidly, approaches it at every point. As the intestines are now all in the abdomen, and the umbilical vesicle has wasted away, the umbilical sheath becomes the slender chord, and contains the omphalo-iliac vessels only. At the end of this month, the chord is nearly 3 inches long, its vessels contain more red blood, and it begins to take spiral turns.

The embryo is about 15 lines long in the ninth week; 2 inches in the tenth; 2¼ in the eleventh; and 2½ in the twelfth. Its weight is from some drams to an ounce. Its granular homogeneousness is replaced by distinct tissues: muscular substance is visible, and the largest muscles are distinct: the nerves are discernible everywhere: the skin becomes distinct. The embryo becomes straighter.

The head is globular, and the nuchal tubercle disappears. The base of the cranium is cartilaginous: the sella turcica and clinoid processes are distinguishable. The vault of the cranium is still membranous in the ninth week: the forehead projects: ossification extends in the os frontis, from the superciliary arch, and the first points of ossification appear in the os occipitis before the foramen magnum, in the great and small alæ and pterygoid processes of the sphenoid, the squamous processes of the temporal, and in the parietal.

The spinal chord, from being a gutter, becomes a cylinder, with a canal a little larger at the central extremity of the nerves of the limbs than elsewhere, and showing no other trace of its former opening than a small fissure behind. The lateral parts of the cerebellum are united in the median line by a narrow lamina, and form the excavated roof of the fourth ventricle. The corpora quadrigemina are two hollow hemispheres, lying against each other, not united, and, except a slit in the median line, covering the aqueduct, which is a vast cavity. The pituitary gland is very small. The hemispheres of the cerebrum are still delicate vesicles, but, as they grow backwards and inwards, they cover the optic thalami. The anterior lobes are formed; the middle but imperfectly; and the posterior are indicated only. The fore part, or knee, only of the corpus callosum is formed; and behind that the anterior pillars of the fornix arise from medullary eminences, and are bent backwards, but do not unite, nor extend above the optic thalami. The anterior and posterior commissures are visible. The ventricles of the cerebrum and the plexus choroides are very large. The olfactory bands are short, key-shaped, and hollow.

The face lengthens somewhat. The zygomatic arch receives a filament of ossification from the zygomatic and temporal bones. The upper jaw forms a triangle, the base of which is the alveolar edge. The palatine process is almost perfectly ossified, and completely separates the nasal and buccal cavities. The articular and coronoid processes of the lower jaw begin to be distinguishable: points of ossification commence at their summits, and at the angles of the jaw. The alveolar edge of the two jaws is indented, from the internal developement of the 16 follicles for the incisor and two front molar teeth: the lower jaw is still but little elevated, is rounded, and, till the end of the month, without chin, and its lower edge is continuous with the chest.

The eyelids are still, in the ninth week, narrow and circular folds of skin. In the tenth week, they form at their inner side a vast lachrymal sac, situated lower than the external angle of the eyes, so that the slit of the eyelids is rather oblique. In the eleventh week, their edges touch and cohere: the membrana pupillaris forms.

The external ear acquires the form of a spiral line; and the helix, antihelix, and tragus arise: it is flat, and the concha not hollow. From being a thin fold of skin, it contains a little cartilage. The meatus auditorius is closed by unctuous substance. The frame of the tympanum ossifies. Its ossicula appear in the ninth week, and begin to ossify in the twelfth. A cartilaginous mass, separate from the petrous portion, represents the labyrinth, whose cavity is lined by a membrane. The cochlea is a thick membrane, and of its permanent form. In the twelfth week, the first points of ossification appear both around the fenestra rotunda, which is almost parallel with the membrana tympani, and in the superior and posterior semicircular canals.

The nose is broad and scarcely projects; its openings are very close to the mouth, directed forwards, divided by a broad partition, and stopped by a sort of cutaneous mass. From being membranous it becomes cartilaginous; the alæ form; the partition narrows; and, in the twelfth week, ossification commences in the nasal bones. The turbinated bones are only projections of the mucous membrane; the cribriform plate is only a fine membrane.

After the ninth week, the lips grow as slight cutaneous folds, like hems; the lower more slowly than the upper, and situated farther back. Towards the twelfth, they touch each other, and close the mouth; and the tongue, which before was protruded from the mouth, retires. The palate is developed in the tenth week, and the salivary glands appear as vesicles resting upon ramified canals of mucous membrane.

The neck grows between the head and trunk, short and thick. The ribs lie close to each other, and all but the lowest ossify. At the end of the month, from being rounded, they form an angle. Some muscular fibres appear in the diaphragm: its tendinous part is proportionally very large. The bodies of the vertebræ ossify from the 5th cervical to the 5th dorsal. The arches are formed in all the cervical.

The os hyoides is visible in the ninth week. The thyreoid and cricoid consists each of 2 lateral parts. The cartilaginous arches of the trachea appear as narrow transverse bands, more delicate in the median line, where, consequently, it is flatter. The lungs are white, dense, at the back of the thorax, and covered by the heart: deep slopes divide them into the lobes: the lobules are not quite united together, and they make the surface irregular by projecting as vesicles. The thymus consists of 2 small flat bodies, behind the upper part of the sternum, united at their lower extremities.

The heart is at first nearly half as large as the liver. It becomes more conical, chiefly by the swelling of its right edge: the venous part grows broader, and the arterial longer and pointed. It at length lies a little obliquely, the apex being directed to the left. The pericardium is completely developed. The auricles, especially the right, are very large: the right half of the organ is the larger. The depression between the ventricles is not so deep. The valve of the foramen ovale forms. The Eustachian valve is very large, and directs the blood of the superior cava from the inferior into the right ventricle, and the greater part of the blood of the inferior into the left side of the heart. The pulmonary artery runs straight, as the canalis arteriosus, towards the middle of the arch of the aorta, is equally large, and opens into it: at a later period this canal inclines to the left, bends somewhat, and unites with the aorta below the origin of the left subclavian, forming properly the descending aorta, and receiving but little blood from the left ventricle. The descending aorta ends in the iliacs, which send very small branches only to the pelvis and lower extremities and are continuous with the umbilical arteries.

The liver becomes more firm and red; occupies the chief part of the abdomen, though its left lobe does not descend so low as previously; its ducts are very distinct, and the gall-bladder is long and rather conical.

The stomach is short, broad, and empty. During this month, from being vertical, it gradually becomes horizontal, and makes nearly a right angle with the œsophagus and duodenum, which are perpendicular. Its left extremity begins to project, and its upper margin to become concave.

The umbilical opening is reduced to a line, and lies higher, because the hypogastric region has become longer. The umbilical vesicle vanishes, as well as the portion of the omphalo-mesenteric vessels above the umbilicus. The duodenum is very broad, and not distinguishable from the stomach; ascends to the biliary duct, and descends again. The rest of the small intestine makes from 3 to 5 spiral turns at the beginning of the third month, before reaching the umbilicus; after completely entering the abdomen, in the tenth week, it clusters, and lies in the middle and left part of the cavity; its lower portion becomes a little narrower, and its extremity plunges into the large intestine so far as nearly to touch the opposite side. In the tenth week, the appendix cæci appears: the colon obtains its valve, and no longer ascends, but passes from right to left, and then descends:

at twelve weeks it is still destitute of folds and prominences. The diameter of the rectum is no greater. At the end of the month, all the intestinal mucous membrane is uniformly developed, and produces folds and villosities: meconium is formed, especially in the ileum; the round anus lies behind the uro-genital opening; but, as the spine and os coccygis elongate, it becomes an open slit.

The omentum begins to contain masses of fat; at the beginning of the third month, the pancreas appears, composed of granulations cohering little together, attached to the stomach and duodenum, at first perpendicular, but gradually becoming horizontal. The spleen also appears, as a small whitish body, pointed above and below, hanging from the large end of the stomach, and composed of many distinct lobules.

In the ninth week, the renal capsules are as large again as the kidneys; their upper and outer extremity is pointed, and touches the diaphragm; their lower and internal rounded, and by this they are united, though they afterwards separate. They consist of 3 or 4 masses of minute granules, each reposing upon a vessel, as upon a peduncle; and their vascular trunks are as large as those of the kidneys.

The kidneys lie lower; their summits become more separated, but their lower extremities are in contact. In the tenth week, they become as long as the renal capsules: they consist of a number of granules, which, at the end of the month, are united into 7 or 8 lobules, differing in form and size, but principally square; held together by little more than cellular membrane, though slightly also by vessels at their concavity, and arranged in an anterior and a posterior layer. The ureters are very large. The bladder empty; at first narrow, and shaped like an intestine; gradually rounder; though still oblong. The urachus reaches to the navel only.

In the tenth week, the testes are at the side of the kidneys; in the twelfth, immediately below them, shaped like a French bean, and about 2 lines in length: their convex edge is turned outwards and forwards; their concave, inwards and backwards; they are fixed before the psoas muscle by a large fold of peritoneum; and converge by their lower extremity, which is obtuse. From their pointed upper extremity, the epididymis issues, descending behind and a little outwards, along the testes; after which, their prolongation—the vasa deferentia, descend into the pelvis obliquely inwards. The gubernaculum arises at the bottom of the peritoneal sac, nearly in the centre of the crural arch, and ascends to the origin of the vas deferens. The penis is large and retracted; its groove closes and becomes the urethra.

In the ninth week, the ovaries lie near and before the kidneys; and are longer and narrower than them. They gradually descend, from being oblique become horizontal, are irregular in their surface, and in structure almost like a grape. At the end of the ninth week, the Fallopian tubes are separate from the ovaria; they begin by a blind enlargement, and become gradually a little tortuous. The insertion of the round ligaments bounds them on the uterine side; and the future uterus is two long cornua, terminating in a single body, of the same diameter with themselves. The cornua grow shorter and broader than the Fallopian tubes, unite at a less acute angle, and the body enlarges and becomes triangular. The vagina is at first as broad as the uterus, and gradually narrows: it ends in the posterior part of the vestibule, whereas the orifice of the urethra lies more forwards. The clitoris is voluminous, and retracted: but, after the twelfth week, it grows more slowly and is proportionally smaller.

Differences in the general character of the organisation begin to appear in the two sexes, while the genitals are still so similar.

The limbs grow more long and slender, and their roots cease to be covered by the skin of the trunk, but acquire integuments of their own.

The superior are longer and thicker than the lower, and have larger joints. The clavicle, from being broad and nearly straight, is arched in the tenth week, flat at its clavicular extremity, and acquires nearly its permanent form. In the tenth week, a point of ossification appears in the scapula, and the spine of the bone is visible in the twelfth. The bone of the humerus is cylindrical in the ninth week, and points of ossification appear in the radius and ulna: the hand is as long as the fore-arm, and narrower than the foot; lies before the face, and often the fingers are bent inwards: points of ossification appear in the metacarpal bones of the fore and middle finger, and in the third phalanges of all the fingers.

ii. In the second half of the month, ossification begins in each os ilei. The buttocks, from being flat, grow prominent; and the tail disappears. The thigh gradually leaves the skin of the trunk, first in front; and the ends of the bone enlarge. The knee is arched, and the thigh bent on the abdomen. The tibia and fibula show points of ossification. In the tenth week, the feet, from being extended, begin to form an angle with the leg: the sole is turned inwards. The ankle is formed, as well as the toes, which are less than half the size of the fingers, and pointed: at the end of the month, ossification begins in the metatarsal bone of the second toe.

5. The *fifth* period includes the fourth and fifth lunar months.

i. At the fourth month, the organs no longer grow irregularly, but approach more to their permanent proportions; the resemblance to brutes therefore ceases, and the pure human form is more evident; there is some physiognomy, and the sexual differences are greater. Very distinct fibres are visible in the brain and spinal chord. Fibrin abounds more, and probably from the influence of the fœtal placenta, which is now well grown. The muscles consequently become fibrous and red. Ossification is rapid. The teeth begin to ossify, and the nails to become horny. Movements occur, and the organs of sense begin to open.

In the fourth month, the placenta is much larger, and the chorion has entirely lost its flocculi: the amnion contains some ounces of fluid: the ovum weighs nearly 5 ounces.

The embryo is about 4 inches long from its vertex to the point of the coccyx, and weighs nearly 2 ounces. It becomes bent again, and more than formerly. The head occupies the lowest part of the uterus.

The spinal chord grows fibrous at its surface, but there only. The decussation of the fibres of the pyramids is evident. The ganglion of the acoustic nerve is seen in the rhomboidal sinus. In the cerebellum, the ciliary body and pons varolii appear, though the latter is at first but a narrow band. The tubercula quadrigemina cohere under the median line: the optic thalami are united by the soft commissure: the pillars of the pineal gland which arise from them unite to produce this gland; the pituitary gland is hollow. In the optic thalami are the anterior pillars of the fornix, which is long; and its posterior pillars extend to the cornua ammonis. The ergot is discernible. The hemispheres grow thicker, especially at their origins, or outwards and downwards, and some anfractuosities are visible on their surface: they extend backwards sufficiently to cover a part of the tubercula quadrigemina.

The alæ of the sphenoid have their three faces, and the pterygoid processes lengthen; a bony nucleus forms in its posterior body. The nasal and malar process of the os frontis are still membrane: the angles of the parietal not developed. The points of ossification of the occipital unite: the articular processes are reniform: the basilar portion filiform.

The eye is more convex; the lids united by epidermis, separated within only: the caruncles project: the sclerotic is translucid, but firm; the chorioid brown, and black in front; the iris narrow; the spherical crystalline lies immediately behind the transparent cornea; the retina is thick in front, finer behind.

The shape of the ears is nearly perfect, but they are flat: the cavity of the tympanum very narrow, so that the wall of the labyrinth is close to the membrana tympani.

The nose is still broad and flat, and the nostrils large; but the alæ grow, and the vomer ossifies.

The gutter of the upper lip is formed; the mouth proportionally small and close; the tongue thicker and less flat, and placed still farther back. The uvula unites completely with the velum, and the bony palate is perfectly formed and excavated. The angle and condyles of the lower jaw form; the mental and suborbitar foramina are visible. Four dental follicles, for the canine teeth, are added to the 16. At the bottom of the internal follicles, the dental germ arises, as a soft red body, receiving vessels and nerves from its point of origin.

The neck is very distinct from the head and shoulders. The vertebræ are nearly globular, and the transverse processes very large, especially at the neck. Towards the end of the month, the sternum begins to ossify. The grand sympathetic nerves are remarkable for their size, and their ganglia so large as partly to touch each other.

The heart is more oblique and proportionately shorter than before, but broader. The auricles have lost their predominance, and become smaller, and especially thinner, so as to resemble transparent membrane on which very fine muscular fibres are scattered. The foramen ovale has become rather smaller, and is half covered by the valve, though still as large again as the opening into the ventricle. The blood of the inferior vena cava does not pass so exclusively into the left auricle, although the chief current takes this course, because the foramen is placed on the left side, more forward, and, consequently, more opposite the inferior cava. The pulmonary artery becomes stronger; the canalis arteriosus is a little narrower than it, and passes almost horizontally backwards. The aorta becomes arched higher than before, and is stronger after having received the canalis arteriosus. The tendinous part of the diaphragm bears a smaller proportion to the muscular, and is united with the pericardium more closely than before.

The lungs become red, and proportionally broader. Their surface is more uniform, because their lobules flatten. The larynx is proportionally less voluminous: the lateral parts of the thyreoid cartilage unite in the median line. The trachea is no longer flat, but cylindrical. The thyreoid is long; its lateral halves united, and its granular structure more perceptible.

The liver extends less towards the left, the left lobe not having grown proportionally with the abdominal cavity; but still descends on the right side as far as the ossa ilei. The gall-bladder contains mucus; is quite vertical, and longer than before. Folds are seen on its internal surface.

The stomach lies across: from the great developement of its left extremity it seems round: its curvatures are more extensive, and its walls thicker than those of the duodenum; folds are visible within it, and the pylorus forms. The diameter of the small intestine becomes more uniform; the duodenum acquires more villosities, but still has no valvulæ conniventes : the apertures of the biliary and pancreatic duct project in the form of tubercles, and are half a line apart. The large intestine begins to have its permanent situation, the cæcum placing itself on the right ileum, and the colon ascending before it crosses the abdomen: the appendix cæci becomes more slender and tortuous: the rectum has longitudinal furrows, and differs from the colon in thickness.

The spleen becomes gradually broader. The pancreas is surrounded by a more dense cellular membrane; its granulations lie closer together, and its duct has a considerable diameter.

The renal capsules are not so granulated; but more homogeneous, whitish externally, and yellowish within. The kidneys equal them in size, and are larger, proportionally to the whole body, than before. The lobules of their anterior surface begin to unite; their middle portion becomes larger, in proportion to their extremities and cornua. The greater part of their pelvis is still open: the front of the organ is not so broad as the back. The urinary bladder becomes more round; and has its first rugæ within, but contains mucus only. The urachus ceases to be hollow at the distance of 2 lines from it.

The testes lie some lines below the renal capsules; and touch the ossa ilei, which have now grown considerably: they receive vessels at their upper edge. Their proportionate size is not so great as before; but, on the other hand, the epididymis is more developed; and the vas deferens runs first upwards, and then downwards. The gubernaculum is stronger, and rests on the inguinal region. The penis begins to bend about the end of the month.

The ovaries are proportionally smaller than previously, rounder, nearly as broad as long, convex above, concave below, and much sloped at their two borders: they no longer resemble the structure of a grape, and are placed horizontally, some lines below the kidneys. The Fallopian tubes have advanced forwards; are longer, more tortuous, and seem to acquire an opening at their origin. The womb, whose cornua are now effaced, is a simple cavity, but its upper edge still concave. The clitoris acquires a prepuce, and lies rather more backwards: the nymphæ are more distinct from the labia.

The shoulders are more developed; the hands broader; the fingers thick. The metacarpal bones are entirely ossified, the first phalanges have points of ossification, and those of the third increase. The two upper vertebræ of the sacrum ossify; the extremity of the os coccygis projects no longer.

The lower limbs grow now as long as the upper, and larger than them at their superior part. The patella becomes cartilaginous: a trace of calf is visible. The metatarsal bones ossify; as well as the third, and ultimately the second, phalanges. The toes are now proportionally shorter than the fingers: both present membranous rudiments of nails.

ii. At the fifth month, the ovum is about 6 inches long, and 5 broad; and weighs nearly 6 ounces. The fœtal placenta acquires a diameter of about 4 inches. The length of the embryo from the vertex to the anus is from 5 to 7 inches, and from the vertex to the points of the feet from 8 to 10 inches. It weighs from

5 to 8 ounces. It now touches the amnion, and has a spherical form. About the eighteenth or nineteenth week, the mother feels the fœtus move; at first faintly and seldom; but at length perceptibly to another person whose hand is placed on her abdomen.

The hemispheres of the cerebellum are developed; and four transverse grooves indicate its division into five lobes. In the cerebrum is seen the septum lucidum, whose cavity is continuous with that of the third ventricle. The corpus callosum extends above the corpora striata. The hemispheres do not yet extend above the corpora quadrigemina. The first traces of convolutions are seen on their internal surface only or that turned towards the middle line. The proportion of the head to the body is as 1 to 3. The face becomes longer and broader, and the forehead more developed and round. On the skin of the cranium, eye brows and lids, small perforated elevations appear for the hairs which sprout up the next month.

The eyelids are very convex, and no longer united by epidermis: their separation is indicated towards the end of the month by a line visible externally. The caruncles and puncta are large, and resemble folds applied together. Vessels are discernible in the membrana pupillaris.

The growth of the face causes the ear to stand farther back, and more distant from the eye and mouth. All its parts are now formed, though not of their permanent shape. The frame of the tympanum unites with the pyramid; the Eustachian tube is cartilaginous; the external semicircular canal begins to ossify, and the whole labyrinth attains nearly its full size.

The nostrils open again; the ethmoid and turbinated bones begin to ossify.

The mouth has a less proportion to the breadth of the face, and opens a little. The upper lip is very large, and its gutter flat. The cheeks are more distinct: the palate widens behind. The four follicles of the third molares are added to the former 20. Ossification begins in the milk teeth: the summits of the future crowns appear on the free surface of the dental germ as small fine scales, which gradually become more solid and thick, unite, and surround the germ. This is observed first in the external incisors, then in the inner, and at last in the anterior molares.

The apex of the heart lies still more to the left; the right auricle is much larger than the left: the foramen ovale is smaller and its valve longer: it is directed from left to right and from above downwards. As the inferior cava is now higher, less blood flows from it through the foramen ovale.

The lungs become larger and redder, and contain more blood. The larynx and trachea contain a mucilaginous fluid. The thyreoid is proportionally more voluminous and broad. The thymus has grown as much, and is composed of small round grains.

The hypogastric region grows more, so that the navel lies higher.

The liver is redder and more dense and its size proportionally less: the gall-bladder is more horizontal, and contains a greenish yellow mucus.

The stomach has longitudinal folds and villi. The duodenum also has projecting folds. The orifices of the biliary and pancreatic ducts lie nearer. The villosities of the large intestine and of the lower part of the small become less than those of the upper part of the small. The tranverse arch of the colon begins to present enlargements. The rectum becomes tortuous; the anus is closed.

The kidneys receive more blood: the rugæ of the bladder are larger, and clear urine is found in it.

The testes are broader, though not longer. The vasa deferentia proceed in a serpentine course towards the pelvis, dilate below, and are continuous with the vesiculæ seminales, which are tortuous. The gubernaculum is triangular; its summit is at the highest part of the scrotum, a little below the inguinal ring, and its base at the lower part of the epididymis. The peritoneum forms a sac at the crural arch. The scrotum is more prominent, and its raphé distinguishable. The penis is rather bent downwards; the prepuce is an annular fold, extending towards the gland. The prostate appears as a very small body.

The ovaries become proportionally smaller, and are situated in the large part of the pelvis. The Fallopian tubes are more serpentine, and have large orifices. The uterus has a straight upper border, and begins to descend into the lower part of the pelvis. The vagina has folds, and the hymen is produced by two lateral elongations. The clitoris bends in consequence of the shortening of its inferior portion, but is not yet covered by the labia. The mons veneris becomes more prominent.

The fore-arm is bent on the chest towards the head. The lower limbs have a larger muscular mass than the upper.

6. The *sixth* period comprises the sixth, seventh, and eighth months. In it, the embryo may be born alive, respiring and moving some time after separation from its mother, but it is called in Germany an abortion or miscarriage, and, unless very near the end of this period, it generally dies.

i. In the sixth month, the ovum weighs about 8 ounces. The embryo is 12 inches long, and weighs from 12 to 16 ounces. The umbilical cord has convolutions. The skin becomes downy, except on the palms, soles, and the seat of the organs of sense and generation. The vernix caseosa appears, though scantily and it is more mucilaginous than fatty. The fat increases under the skin, particularly at the cheeks, nucha, and abdomen. The nails grow horny. Some small hairs are visible on the wrinkled skin of the head; the eyebrows and eyelashes also come. The nipples appear as small rings.

The head is a quarter as long as the body. A great part of the cranium is ossified. The corpora olivaria are seen on the chorda oblongata. The lobes of the cerebellum are divided into lobules by fresh transverse grooves; the cerebellum is thicker, and the fourth ventricle within it is consequently shorter. The mass of the tubercula quadrigemina is also thicker within, so that their cavity is lessened. A whitish, but not fibrous, substance is deposited on the surface. The pituitary gland is large, red, and juicy. The corpus callosum extends beyond the anterior part of the thalami optici. The hemispheres of the cerebrum cover the tubercula quadrigemina and cerebellum; they become thicker, since fibres of reinforcement are added to the rays of the crura cerebri which alone constituted them previously.

The forehead is furrowed; the face wrinkled like that of an old man. The cornea is pale; the crystalline soft, opake, and as it were mucilaginous; the membrana pupillaris solid.

The lobe of the ear is developed; the ear still very large; and the helix not very distinct.

The nose and septum are no longer so large; the nostrils are open, but filled with mucus.

The mouth is open, and contains a white thready fluid. The tongue is thick and red, and has a granulated surface and a long frænum. The parotid is broad and granular, and has a large excretory duct.

The heart is proportionally smaller, and less round: the auricles rather smaller in proportion to the ventricles.

The neck is very long. The thyreoid proportionally not more voluminous than before. Cartilaginous rings form in the trachea. The pulmonary arteries are larger. The lungs are solid, cellular, and cannot be inflated without much force; on inflation, vesicles appear of the size of poppy seeds, and the air immediately comes out again.

The liver ascends, and pushes up the diaphragm. Its diameter increases more from before backwards than from above downwards, whence it projects more upwards, and its right lobe does not descend so low.

The openings of the choledochus and pancreatic duct are neither so prominent, nor so distant from each other. Proportionally, the pancreas is smaller, and the liver much larger.

The renal capsules have deep cells and grooves, with a brownish fluid. The kidneys are proportionally larger; and are as big again as the capsules. Their lobes are more confused within, and separated at their surface only and by furrows. The ureters are long and rather red. The urine in the bladder is scanty, colourless, and odorous.

The testes lie on the ossa ilei and psoæ; still bent back.

The ovaries lie deeper. The Fallopian tubes are more horizontal, and each has a large fringed opening into the abdomen. The upper and posterior surface of the uterus is more convex. The clitoris is concealed by the labia.

ii. In the seventh month, the ovum weighs about 12 ounces. The embryo is about 15 inches long, and weighs about 2 pounds.

The skin is very vascular. Epidermis is discernible, especially on the hands and feet. The abundance of fat renders the form more plump. The rings which are substituted for nipples are composed of the open orifices of the lactiferous tubes, disposed in circles.

The length of the head is only a fifth of that of the body. The canal of the spinal chord is narrower. The cerebellum is divided into more lobules. The fimbriæ and two posterior medullary valves are very evident. The pons varolii augments. At this period are the tubercula quadrigemina first divided by a transverse groove into an anterior and posterior pair: at the same time, they become so thick internally that the aqueduct is no longer a spacious cavity, but a narrow canal. The corpus callosum extends above the thalami optici. The mammillary eminences are separate. The hemispheres extend over the cerebellum, and some convolutions are discernible on their upper and outer surface. The lateral ventricles are still large, and filled with the plexus choroides.

The eyelashes are longer and stronger. The puncta project less. The cornea is more convex. The membrana pupillaris more completely grown.

The ossicula of the ear are quite ossified.

The germs of all the milk teeth bony.

The thyreoid is rounded, and thicker. The thymus proportionally larger.

The Eustachian valve pushed to the left; the valve of the foramen ovale larger, so that the foramen admits less blood.

Bile exists in the gall-bladder. The villi of the large intestine have disappeared. The cæcum is more distinct from the colon, and the opening of its valve lengthened. More meconium is found in the rectum.

The kidneys are larger, and covered with a little fat: there is but little urine in the bladder.

The testes are near or in the inguinal ring, but a little pressure pushes them back into the abdomen. The prepuce extends over the gland.

The hymen projects considerably. The labia are full.

The upper extremities are bent on the chest, and the fingers bent. The thighs are equally bent on the body, the knees turned outwards, and the feet inwards and applied to the genitals.

iii. In the eighth lunar month, the ovum is about 9 inches long, and weighs a pound. The embryo is 16 or 17 inches long, and weighs 3 or 4 pounds.

The orifices of the lactiferous ducts are more closed, and the nipple begins to project. The nails are still soft and short.

The cavities of the pituitary gland and olfactory band are obliterated, and that of the septum lucidum closes.

The eyelids lie less close together. The cornea is less obscure.

The centre of the membrana pupillaris begins to disappear.

The semicircular canalsare quite ossified.

The os hyoides ossifies.

The 2 semilunar valves of the foramen ovale approach more, and allow less blood to pass. The proportion of the canalis arteriosus to the pulmonary branches lessens.

The cartilages of the larynx and trachea are more solid, and the lungs more cellular.

The liver is of a deep red; and the urine straw-coloured.

One testicle, generally the left, descends into the scrotum, while the other is still below the ring in the inguinal region. At this time only does the vas deferens bend upon itself, after having descended along the testicle, and then it ascends.

The womb attains its permanent form. White gelatinous mucus fills the vagina, and the vulva is open.

7. The *seventh* period includes the ninth and tenth months.

i. The vitality of the fœtal placenta lessens: the circulation through the lungs is stronger; and the heart favours the separation of the two circulations more and more. Thus the embryo prepares to leave its mother: when the separation occurs at the beginning of the period, there is no abortion, but a premature delivery; *i. e.* the fœtus may live, though not yet at maturity.

In the ninth month, the ovum weighs 4¼ pounds. The embryo is 17 or 18 inches long, and weighs 5 or 6 pounds.

The down begins to fall off, and the hairs lengthen: the nails are firmer.

The bones of the head extend nearer together, and the fontanelles lessen: the hemispheres of the cerebellum grow more towards the base and the posterior part. Most of the convolutions of the cerebrum are in the anterior and middle lobes.

Some fragments only remain of the membrana pupillaris, floating at the edge of the iris.

The larynx and trachea are completely ossified, and contain a thin mucus.

The bile is of a bright green, mucous, and mild.

The coats of the intestine are thicker, and the muscular is distinguishable. The meconium is darker, and viscid.

The canal of the peritoneum into the scrotum is still open.

The limbs are fuller and rounder.

ii. At the tenth month, the ovum is 10 or 11 inches long, and 7 broad; 18 or 19 in circumference. The placenta is about 9 inches in its greatest diameter, 24 in circumference, and 1½ thick. The chord is 18 or 20 inches long, and ½ an inch thick. The embryo is 18 or 20 inches long; from 3¼ to 3½ broad at the head and pelvis, from 4¼ to 4½ at the shoulders. The ovum weighs about 1½ pound; two thirds of which depend upon the placenta and chord. The liquor amnii weighs nearly ½ a pound, and the embryo 6 or 7 pounds; so that the whole weight is usually 8 or 9 pounds.

The downy hairs have chiefly disappeared. The epidermis is solid and smooth; the skin dense and of a reddish white. The hairs of the head are pretty long and firm: the nails solid. The cartilages of the ears thicker. The limit between the skin of the embryo and the membranes of the chord is more distinct at the umbilicus.

The spinal chord now reaches to the third lumbar vertebra only. Its canal is grown smaller, and surrounded by a reddish substance. The grooves of the cerebellum are more numerous, and have produced its ultimate divisions, even the amygdalæ. The spaces between the optic thalami and corpora striata are filled up by the dense semicircular bands. The corpora striata lie deeper in the substance of the hemispheres; and the lateral ventricles, though absolutely larger, are relatively smaller than before.

The articular processes of the various bones are more ossified. The first medullary cavities begin to form in the tibia, but contain a jelly only, reddish, mucilaginous, and slightly unctuous. Ossification begins in the second set of teeth, and in the os coccygis.

The muscles are stronger and redder, the tendons more solid and shining, the nates more prominent.

The testes are in the scrotum, and have a tunica vaginalis. The peritoneal canal begins to close.

The labia are in contact, and close the vulva.*

Except the organs of vegetative or organic life, or of nutrition, no part is a prolongation of another, like vegetable shoots. The salivary glands, lungs, liver, and pancreas proceed from the mucous layer; and the vascular glands from the vascular layer; but all the organs of animal life are formed each independently of the other, approaching and harmonising as they grow. The essential organs are generally formed the first. Some parts in embryonic life are below (as the spleen, nose, limbs), others above (as the brain, spinal chord, eyes, ears, great end of the stomach, appendix cæci, liver, heart, supra-renal capsules, thymus, and thyreoid gland), their proportion to others in adult life. Some which are below the adult proportion at the end are above it at the first of fœtal life, as the intestines, tongue, testes, ovary, penis, and clitoris. There is a general tendency to surpass the limits of the due proportion and equilibrium of the perfect state, as exemplified in the elongation of the eyelids at the time the eye is to be covered, till they touch and cohere : in the opening of the mouth extending at first across the face : in the venous and arterial sac, when the heart first divides, being connected by an intermediate canal only : in the distinction of the ventricles of the heart being at first visible externally by a depression : in the fibres of the fœtal brain being more distinct than those of the adult : in the villi of the intestines being longer : and in the mucous membrane and cartilages of the larynx being originally almost separated.[q]

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* These statements of development are compiled chiefly from the inspections of J. Hunter, Albinus, Sœmmerring, Meckel, Wenzel, Reil, Blumenbach, Autenrieth, Tiedemann, Carus, Wrisberg, Baer, Valentin, Kieser, Pockels, Rathke, Müller, Burdach, Senff, Mayer, Madai, and Velpeau. Our old countrymen, "Harvey (*De Generat. Animal.* p. 184. 235. sq. London, 1651), Grew (*Cosmol. Sacr.* p. 37. 47.), Lister (*De Humorib.* p. 444.)" were aware of "the resemblance of the very early human embryo at first to the larvæ of reptiles, and afterwards in some measure to the fœtuses of quadruped mammals."

The periods of growth vary more or less in individual embryos, notwithstanding their general observance: and, indeed, the relative growth of organs is not always the same. These variations occur in all animals. The ultimate period is the same; but, according to original tendencies, the general and individual growth accomplished in the period varies greatly in each being, just like varieties in form and other qualities. Growth in general, " both before and after birth, is more rapid as the age is less, and *vice versâ*." It occurs, however, before birth, according to Autenrieth and Sœmmerring, in an oscillating manner, being, in regard to length, very rapid during the first month, slower in the second, rapid again in the third, slower at the beginning of the fourth, quicker from the middle of the fourth to the seventh, and slower after the seventh; while in other directions the reverse is observed at the same periods. Premature labour is more common at times of the most rapid growth in length.

All the parts above the umbilicus, — the head, chest, upper extremities, and upper part of the abdomen, grow more rapidly than those below it. The same is observed in brutes; the upper extremities grow faster than the lower even in the kangaroo.

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[q] Burdach, l. c. § 478.

As all the solids proceed from liquids, the organs all become more solid as age advances, till they have obtained their due solidity. 10,000 parts of brain taken from a pretty advanced embryo lose by evaporation 8,694; from an adult, but 8,096: of the salivary glands from an embryo, 8,469; from an adult, but 7,600: of the liver from an embryo, 8,064; from an adult, but 7,600.[r] The proper colour and texture are likewise acquired by degrees only; as well, no doubt, as the proper ultimate composition. The secretions are each at first, correspondently with the softness of the solid products of nutrition, watery, and acquire their due intensity of character by degrees only.

The embryo has at first no movement, and Bichat found that, the younger an embryo was among mammal brutes, the greater was the difficulty of stimulating the muscles; and that irritability ceased immediately on its death, and was not of much amount till just before the full time, and then much less than after birth. The human fœtus is large enough in the fifth month to make its motions felt by its mother; these gradually increase in force, and may be felt by others who apply their hand to the abdomen of the parent. They are very irregular. When the hand is applied for a little time to the abdomen, different parts will be felt thrust against it and striking the hand irregularly now in some spot or spots and then in others. The application of cold to the mother's abdomen increases these movements very much. In the last month or two of pregnancy they cease to increase, from the want of room.

When the nervous system is sufficiently compounded and organised for consciousness and motive and will, these would scarcely seem to be excited before birth; at any rate, after their establishment as powers, they remain long inactive, and the child is like any one asleep till birth, and its movements must be the same as those which occur in us unconciously in sleep. Respiratory movements are not possible so early as those of voluntary muscles not concerned in respiration. A fœtus expelled at five months, seldom breathes, though it may move its limbs; one at seven months breathes weakly and irregularly, especially if the air is cool.

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[r] Haller, *El. Phys.* t. viii. p. 266.

Just before birth at full time, nay, even at the seventh month, a fœtus has occasionally cried. Cases of *vagitus in utero* have been often published in German collections[s], on excellent authority, but generally dismissed in this country as too ridiculous for credit. Burdach remarks, that generally there have been violent movements of the fœtus at the same time; an unusual developement of the lungs; a disengagement of gases in the amnion, or something else morbid; and that most such children have perished soon after birth. He suggests that, if the liquor amnii happen to be greatly reduced, air must supply its place, though generally this may be unfit in quality and insufficient in quantity for respiration, and the child's position must prevent the act.

The facts which have been just detailed present one of the magnificent views of the universality and simplicity of the plans, by which results, so different from each other, are effected in nature. A hand, a hoof, a paw, a fin, a wing, are identical fundamentally; so are the gills and bivalve shells of mollusca, and the wings and elytra of insects, the proboscis of the elephant, and the human nose: but they have variously grown; and the case is the same with all organs. They grow, with their constituent or elementary parts, so variously in different animals, that their identity is not recognised without study: but still one idea, one plan, carried shorter or farther, varied in this way or in that, pervades all animal formations, although the results — the function and shape, may have no analogy in different animals.[t] "The organs of the higher, and those of the lower tribes, if not of plants, certainly of animals, are, in both, essentially the same; the nucleus or structural elements of each organ in the former not only existing, but being, in fact, in all their essential characters, identical with those of the corresponding organ in the latter; so that the history of the advancement of each organ towards perfection is merely the history of the progressive developement of an imaginary unity. And as the more elevated tribes of animals embrace generally, in a greater or less degree, every improvement successively made in the moulds of the several organs of the tribes below them, the splendid human organisation itself consists merely of the same organs, regarded fundamentally, as exist in the polype: the difference consisting, chiefly, in their different degrees of elaboration." Thus, in the words of Dr. Grant, " in every case where we imagine we have got elements that do not exist in other animals, but only in the particular species we are examining, they exist under another form in man." " If we prosecute this scrutiny from the highest to the lowest, we advance by such insidious steps, that we never lose sight, for a moment, of the nucleus, as it were, of our crystal, however varied it may become in form and office; and are at length surprised, on arriving at its extreme developement, to perceive that the organ from which we started, and that with which we finish, and which do not, perhaps, when placed abruptly in juxtaposition, present a single point of resemblance, anatomical or physiological, are, in fact, rude copies of each other."[u]

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[s] See an abundance in Hesse's work, entitled *Ueber das Schreien der Kinder im Mutterleibe*, p. 57—72.

[t] Aristotle founded his classification of animals very much upon this doctrine of unity of organic structure, or theory of the analogies of organs; unfortunately, he was not content with it, but fancied a unity and analogy of form and function, and thus admitted great error into his system. Geoffroy St. Hilaire pointed out his errors, and set the doctrine right, in his *Philosophie Anatomique*, 1818. His views are now adopted by the best naturalists on the Continent; though Sir C. Bell, with the same ignorance and assurance with which he treats phrenology, says, sneeringly, in irony, that St. Hilaire's conceptions deserve to be marked as the commencement of a new æra. (*Bridgewater Treatise*, London, 1834, p. 154.) Dr. Grant speaks, throughout his lectures, of the

It is, however, more correct to say, with Dr. Knox, that the unity is rather of structural elements, or primitive types, than of organs, in the series of animals; since a portion which is found in one organ of one animal may be found in another organ of another animal. For example, the os hyoides loses two of its elements in man, which are found as portions of the temporal bones and termed styloid processes, as well as other portions found in other contiguous parts, so that it has none of the appearance of the

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ingenuity and boldness of the speculations of St. Hilaire, and says that we are a century behind our Continental neighbours in this department of science and thus " his views are very inadequately appreciated among us."

[u] Dr. Fletcher, *Rudiments of Physiology*, part i. chap. ii., in which he has compiled so well on this subject, that I have not hesitated to borrow either his details, or his clear and forcible language.

complicated pharyngeal bone of fishes and reptiles; and, on the other hand, the distinct intermaxillary bone of so many of the lower tribes forms one bone, in man, with the lower jaw. Nor is every part more developed in the higher than the lower tribes. The large opercular bones of fishes are the small bones of the tympanum in man: the large coracoid arch of fishes becomes the furcula of reptiles and birds and the small coracoid process of man. I remarked at page 2., that the scale of animals, though real, was not regular and uniform; that a lower animal might in one point excel a higher; and, on close anatomical investigation, a part may be found poorly grown in a higher species that is large in a lower; a part may be found in a single species, or variety, or tribe, in a condition in which it is found in no other species, not to say of that tribe, but of other tribes for some distance above or below it. Some parts arrive, in some lower animals, at a higher degree than in higher animals. ".The central organ of sensibility," says Burdach, "is at first hollow in all vertebrate animals, and the spinal chord retains a cavity in all brute mammalia, whereas this is completely filled in the human embryo: but in fish the cerebral vesicles are also completely filled, while in man their cavity is diminished only." The stomach, at first like an intestine, is gradually divided by strangulations; but this difference goes much further than in man. The cartilages of the trachea grow from before backwards; but, whereas in man their posterior extremities only approach each other, in saurian reptiles and birds they become perfect wings.[x]

Before arriving at a higher grade natural to any particular animal, each organ passes through the inferior grades natural to some other animals; and, as Dr. Grant remarks, "we witness the same stages of developement, by tracing it through the highest animal in the course of its progressive elaboration, as by tracing it through the great body of the animal kingdom." The science of the stages of all the organs in different animals, and at different periods of the same animals, is denominated Transcendental Anatomy. The gills of mollusca and osseous fishes are met with in all superior tribes at one period of their progress to maturity, — when they have passed through about one sixth of their incubation. The heart of the fœtuses of fishes is moulded on that of invertebrate animals: that of the fœtuses of fish and reptiles is originally the same, — a simple tube, which gradually becomes contracted in the middle, and afterwards turned upon itself, so that the auricular is brought above the ventricular portion; but in the higher reptiles, a partial division of the two sides takes place. In the chick, the heart, about the thirtieth hour of incubation, is a simple tube, lying in the neck, as it does permanently in fish: about the forty-fifth hour, it becomes contracted in the middle, and turned upon itself; and about the sixty-fifth hour, a division of the two sides begins to take place, — first in the ventricle, and then in the auricle, which about the sixth or seventh day leaves no communication except the foramen ovale. The heart of the dog is a mere tube, contracted in the middle, turned upon itself, and lying in the neck, about the twenty-first day of utero-gestation; that of the human embryo, about the fourth week: both cavities afterwards divide, first the ventricle, and then the auricle; and at the end of the third month the foramen ovale is the only spot of communication. The five branchial loops, arising on each side from the single vessel which proceeds from the heart of osseous fishes, are repeated almost without change in the fœtuses of batrachian reptiles; and, in proportion as the gills disappear, those branches which went to them become also obliterated; and of those which remain are formed the two aortæ, and from these branch off the pulmonary arteries, &c. In the embryo of serpents and lizards, the same primary trunk and its loops are seen, and become the carotid and subclavian arteries, and aorta and pulmonary arteries. In the chick, and the fœtus of brute mammals, and in man also, as I formerly detailed, the same five loops are discovered along the borders of the clefts of the pharynx, and some become obliterated, others enlarged; so that the carotid and subclavian are produced, with the single aorta and pulmonary artery.

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[x] l. c. § 477. 4°.

The condition of the human brain, in the description just given of its growth, is similar, before the second month of pregnancy, to that of an invertebrate animal; at the second month, to that of an osseous fish; at the third, to that of a turtle; at the fourth, to that of a bird; at the fifth, to that of one of the rodentia; at the seventh, to that of one of the digitigrada; at the eighth, to that of one of the quadrumana; till, at the ninth month, it has the genuine human stamp. Not that the fœtal human brain, perhaps, at any time perfectly resembles that of any individual among lower animals; for the brain of all osseous fishes, turtles, birds, rodentia, digitigrada, quadrumana, is not precisely the same: but it represents their brains in general, — the aggregate of their brains. Nor that, although the germs of all animals start together, — some, as that of the zoophyte, proceeding but a short way, and reaching and stopping at their destination almost instantly; that of the molluscous and articulated animals, annelida, crustacea, insecta, successively, farther and later; that of fish, reptiles, birds, and quadrupeds, successively, farther and later; and that of man, the farthest and latest of all,—the human embryo, at any period of its growth or organogenesy, so far resembles an inferior animal, that it can be mistaken for one,—that all the organs, at any period of the human embryo's growth, resemble all the organs of another animal: for each organ grows more or less independently of every other; and, while one at a given period may resemble that of a fish, another resembles that of a reptile, a third that of a bird, and a fourth that of a quadruped. Consequently, as Dr. Rudolphi says, "the human embryo is still a human embryo, distinct from all other animals and animal embryos, and never was a worm."[y] Still man is at first a kind of zoophyte. He so resembles an hydatid, — a cystic entozoon, that he might be mistaken for one; and the human embryo gradually, though irregularly, passes up the scale of animals, irregular as I have represented this of itself to be. An immature molluscous animal corresponds *very nearly* with zoophytes; and an immature animal of the family of annelida with a molluscous animal; an immature crustaceous animal with one of the annelida; and an immature insect in the state of larva with one of the annelida, and in the state of pupa with one of the crustacea: an immature frog, or salamander, is very nearly a fish.

It is apparent that, the lower the animal, the more its organs are diffused and subdivided; and that increase of excellence is associated with increase of concentration. The organs of plants differ from those of animals in being at once more diffuse and more simple, and in not being contained in specific cavities, like the viscera of animals, but tending all towards their surface; and so diffuse are they, that some are mutually convertible. In zoophytes, the respiratory organs are as diffuse and as undistinguishable from the general surface as in acotyledonous plants; but, as we advance through the other vegetable tribes, as well as the other tribes of invertebrated animals, they assume the appearance, first, of distinct vesicles, opening in plants by stomata of various forms on the surface of their leaves, and in animals by different kinds of apertures on the surface of various parts of their bodies; in insects, the different stigmata opening on the surface of the body are prolonged into tubes which ramify throughout every part of their substance. In the vertebrata, they are much less diffuse, though some fish breathe by numerous vesicles, called internal gills, the entrance to which is from their gullet, while the exit is in general by corresponding apertures on the sides of the neck; and even those fish which breathe by external and more concentrated gills still conduct the water over them from their pharynx by numerous apertures; the latter seem to employ further their air-bladder, connected as it is in general with some part of the alimentary canal, as an additional respiratory organ, in the same manner as some reptiles, for example the Proteus and Siren, use both gills and lungs, while others have both lungs and a reputedly urinary, although, perhaps, not really urinary, bladder; and it is not till we arrive at the highest vertebrated fishes that we find the respiratory organs settling into a compact pair of lungs. In the lowest vegetables and animals we have merely scattered cells for circulation, which, by their union, form tubes: these tubes are at first diffuse, though distinct, in most plants and some zoophytes; but they at length exhibit dilatations, as seen in the numerous little hollow bands in the vascular semicircles which surround a portion of the intestinal canal of the earth-worm. Similar dilatations in the cuttlefish take the form of the three hearts, and in the ship-worm of two; and, ultimately, we arrive at the one compact heart of the vertebrata: the large arterial, venous, and absorbent tubes are double or still more diffuse in the lower tribes, though single in the higher. In the invertebrata we have often numerous blind pouches connected with the stomach, or even with the whole intestinal canal, or numerous stomachs; in the vertebrata, subdivisions of the stomach are very common. Ramifications, also, or plurality of the organs are found in some; bundles of scattered tubes serve as a liver in most insects; and in the lowest vertebrata, the liver has deep fissures, and the pancreas is a collection of cæcal appendages to various parts of the alimentary canal, and at last is divided into two portions. In the invertebrata, the kidneys are so diffuse, as to appear wanting: and, among vertebrata, in most fishes,they are a diffuse spongy, beaded mass, extending along the greater part of the spine; in most of the lower tribes are lobulated, and in some actually resemble a bunch of grapes. The genital organs may be described as almost universally diffused throughout the substance of such of the inferior tribes of vegetables and animals as propagate by shoots. When distinct sexual organs exist, they are frequently, as in most vegetables and many animals, combined first in the same individual, and in vegetables are generally also scattered over the system. Where the sexes are distinct, the organs are progressively concentrated, the ovaries and testes of the ascaris lumbricoides, &c. being an enormously long convoluted tube and looking like the liver of insects; when these tubes are condensed into solid organs, the ovaries are at first deeply lobulated, and the testes of most vertebrated animals, except man, have the epididymis distinct; the uterus is at first double in the ornithorynchus, then doubly arched in the opossum tribe, horned but not arched in most quadrupeds, slightly bifid in the makis, triangular in the ant-eater, and compact and pear-shaped in woman. The human mammæ are far more concentrated than in most other mammals. The human placenta is a concentration of the cotyledons of quadrupeds, and these of the diffuse corresponding organs of ovipara. In many invertebrata and vertebrata, the whole penis is double; in the opossum, the glans only. "It is probable that quite the lowest tribes of animals, as the polypes" (or rather the zoophytes, of which they are parts), "smell, see, and hear by their whole surface; and in even the mollusca and articulata these organs are much less individualised and compact than in the higher tribes of animals. The organ of smell is in general very obscure, and that of sight, though sufficiently obvious, from the infusoria upwards, generally very diffuse," as instanced in the numerous stemmata of some annelida, and most arachnida, the hundreds and thousands of compound eyes of insects, and the stemmata and compound eyes of others. No animal with a lachrymal gland has it so compact as the ape and man. The tongue of serpents is almost double, and of many birds and some mammalia is slightly cloven.

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[y] *Grundriss der Physiol.* § 129.

If, as some fancy, a few vegetables exhibit traces of a nervous system, it is in the form, not of masses, nor even of chords, but of minute globules; among the lowest invertebrate animals in which it has already been discovered, it is in the form of granules. Next we see it as diffuse chords and knots, loosely connected, and disposed in a circle in the lowest, but in a line running down the body in the greater number, of the invertebrata. The connecting medium of the knots is double in some, single in others, which must thus be supposed to have more concentration; and, in animals considerably farther advanced, the main part of the nervous system is no longer in diffuse knots, but in one large knot, called the thoracic ganglion, in the centre of the body. In those which have a distinct spinal chord, as fishes, reptiles, birds, and mammals, it generally reaches the os coccygis; but, in man, it terminates about the second lumbar vertebra.

Now concentration gradually takes place in the growth of animals. The respiratory organs in general are more diffuse in the imperfect than in the perfect state of insects and reptiles; the larva of the frog, *ex. gr.*, has both gills and lungs, but loses the former as it approaches maturity. In the larva of insects, the stomach and its appendages are more diffused than in the pupa; and in the pupa, than in the imago. This holds among reptiles; the intestines of the frog, for example, not exceeding one quarter of the length they had in the tadpole. In those animals which undergo metamorphoses, the nervous system experiences more concentration as the animal arrives at higher grades of organisation; the chain of knots in insects, for instance, becoming in some much shorter by the coalition of three or four into one, — a circumstance looking like an attempt to produce a distinct spinal chord and brain. The connecting chords, which were at first double, frequently become almost or entirely single in the progress of growth. But, in the growth of the human embryo, the progress of concentration is the most remarkable. The germinal membrane is probably of the nature of a zoophyte, — a uniform mass, consisting, in every point, of rude structures performing offices analogous to those of organs not yet formed. Its first step to concentration is its division into the mucous and serous layers; and afterwards the vascular layer appears. These layers soon cease to be uniform, and farther concentration takes place by the mucous dividing into stomach, intestines, and other organs composed essentially of mucous tissue; the vascular, into heart and large blood-vessels; and the serous, into spinal chord and brain, bones, muscles, and common integuments. Pre-existing central organs do not first form, and shoot towards the extreme points, as Mayer contended[z]; while Serres would have us believe that formation proceeds from without inwards.[a] But each part, each minute vessel and nerve, has a sort of separate existence and development; and coalition of all the separate portions takes place; junction being effected at least as much from the advance of the extreme portions towards the central, as of the central towards the extreme. The perfection and insulation of each organ is, however, slowly attained. Not only are all the organs that are ultimately single, at first double, — as the stomach, intestines, heart, brain, certain bones, and other parts in the mesial line, and concentrated by the union of the halves on both sides of the body; but the proper instrument of each function has, in the early human embryo, the same diffuse character which it presents in the perfect lower animals. The human fœtus, in its progress to maturity, had at one time a kind of gills as well as lungs, to say nothing of the employment of a yelk bag, an allantoid, and a placenta, as respiratory organs; all its large blood-vessels, which were afterwards to become single, were double; the intestinal canal was enormously long and sinuated; the liver double, with each portion deeply indented; the kidneys were long and lobulated; the ovaries of the female lobulated, and the testis and epididymis of the male distinct; the uterus was at first distinctly double, and afterwards bifid; all the conglomerate glands were merely distinct mucous tubes, shooting into gelatinous masses, by which they at length became concentrated; the spinal chord, originally a double thread, extended at the third month to the os coccygis, but gradually shortened, so that at the seventh month it terminated about the fifth, and at the ninth about the second lumbar vertebra; the bones were at first innumerable. The brain, by the more intimate approximation of its parts, becomes one mass; the three segments of the heart become one part: the kidneys were originally like a bunch of grapes; the salivary glands were distinct vesicles; the arches of the vertebræ, and cartilages of the larynx, as well as the general walls of the body, unite into one in the median line.

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[z] Meckel's *Archiv für Anatomie*, 1826, p. 228.

[a] *Anatomie Comparée du Cerveau*, t. i. p. 50. See Gall's powerful refutation of Serres's doctrine of centralisation so far back as 1825. l. c. 8vo. t. vi. p. 355. *sqq*. Even poor Mr. Miller saw facts against it. *Lancet*, 1838, No. 762. p. 59.

It must strike us, however, that, the higher the degree obtained by an organ, the greater is its complexity. But this seems to me no exception to the rule of its greater concentration. For, in fact, complexity of organ occurs only where there are additional or more exquisite results. The law of nature's works, and of man's, is the same. Every advance is marked by more numerous and more exquisite results, but necessarily by more numerous means for the production of the more numerous results: and, in order to render these more exquisite, the means become divided, separate divisions being requisite for separate divisions of each result. Division of labour is as necessary in nature as in art, for exquisiteness. In truth, the greater complication of an organ, in proportion as the results are more numerous or exquisite, is virtually concentration. If the whole were as simple as previously to the advance of the results, this would be virtually increased diffusion, — the means of more numerous results would be in a state of diffusion throughout the organ. But each portion takes a subdivision of duty, and this is virtually concentration. The brain of a lower animal is more simple than that of a higher. Its fewer parts do everything. The higher animal has more faculties, and more exquisite degrees of faculties: accordingly, its brain has more parts — organs, notwithstanding that every part which it has in common with the inferior tribes is more concentrated. The greater complexity of a perfect organ, as the farther and farther subdivision of the fibres of nerves, muscles, and tendons; the division of the heart into arterial ventricle and venous sinus, of the facial cavity into nasal and oral, of the alimentary canal into stomach and large and small intestines, is no more than the existence of serous, mucous, and vascular layer where before there was merely the germinal membrane, or the existence of numerous organs where before there was merely serous, mucous, and vascular layer. The means for the more numerous and exquisite results must be multiplied; but each of the means, nevertheless, becomes more concentrated the higher we ascend; — as in art, the means are subdivided into sets, but, at the same time, each set simplified. Complexity of organs increases from the first period of growth, and concentration of each individual organ advances till each organ is finished. Division into new portions, and the rise of new portions for new purposes, are going on from the first; while any organ or portion of an organ remains perfectly the same in its results, it never becomes more complicated[b], but still constantly more concentrated till it is finished.

Harvey remarked that, the higher the ultimate developement of animals, the more rapid is the progress through the stages. "The embryonic life of the chick is 3 weeks, and of man 40; the third day of the chick, therefore, corresponds with the sixth week of man: but the human embryo makes far greater progress during these first six weeks. Hence the transitory organs of the embryo disappear sooner in man than in brute mammalia. But this rapidity renders it difficult to study the first stages of the developement of mammals, and drives us to the analogy of birds."[c]

Since the preceding pages were written, Dr. Martin Barry has published farther investigations in the ovum of the rabbit.[d] The following are his discoveries.

An immature ovum has oil-like globules diffused in a fluid The mature presents a peripheral stratum, sometimes of granules. sometimes of vesicles pressed together in a polyhedral form; the centre being fluid.

The oil-like globules are vesicles; and contain other vesicles, opake internally, and often compressed into an irregular shape. They collect and perhaps originate round the *germinal vesicle.* Maceration has an effect like that of impregnation; as far as it distends the chorion — a thick transparent membrane which was considered by him and Coste and Wagner to be and probably is the vitellary membrane in birds and was called by some zona pellucida, while the yelk ball retains its size and form, — a proof that this has a proper membrane. During maceration, the germinal vesicle, previously to disappearing, sometimes becomes elliptical.

During the period of rut, Graafian vesicles enlarge and grow vascular; and more of them than discharge ova. In such Graafian vesicles, the germinal vesicle, as was stated in the former paper, has moved to the surface of the yelk, and the ovum to that part of the surface of the Graafian vesicle which is nearest the exterior of the ovary; and the yelk is matured. The germinal vesicle is often at that part of the surface of the yelk which is nearest the surface of the Graafian vesicle, and therefore nearest the surface of the ovary. The fluid of the Graafian vesicles which are near the surface becomes more viscid, and this change, as well as changes of the yelk, increases as the period of the rut advances.

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[b] That increase, concentration and complexity, are not uniform in the scale of animals, has been illustrated at pp. 2. 932. sqq. See also *infrà*, p. 945.

[c] Burdach, l. c. § 476. 6°.

[d] *Phil. Trans.* 1839, Pt. ii.

After coitus, the ova of the rabbit destined for developement are very frequently discharged at the end of 8 or 9 hours, though the condition of the animal, and especially the period of the rut, probably cause great differences in this respect. All the ova of one impregnation appear discharged about the same time. If an unusually large number escape from one ovary, fewer proportionally escape from the other.[e]

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[e] The sow from which John Hunter extracted an ovarium (*suprà*, p. 783.) produced in her time about half the number of pigs produced by an unmutilated sow, but at eight farrows only; whereas the entire sow farrowed thirteen times. He took two young sows in all respects similar to each other, and, after removing an ovarium from one, admitted a boar of the same farrow to each, and allowed them to breed. The perfect sow bred till she was about eight years old, — a period of almost six years, in which time she had thirteen farrows, and in all one hundred and sixty-two pigs; the other bred till she was six years old, — during a space of more than four years, and in that time she had eight farrows, and in all seventy-six pigs. Thus it would appear that each ovarium is destined to afford a certain number only of fœtuses, and that the removal of one, although it does not influence the number of fœtuses produced by the other, causes them to be produced in a shorter time. (*An experiment to determine the effect of extirpating one ovarium upon the number of young produced.* In his *Observations on certain Parts, &c.*)

Domestication affects fertility. " The domestic sow brings forth commonly two litters in the year, each of which consists perhaps of 20 young ones. The wild animal, on the contrary, becomes pregnant only once in the year, and the number of its young never exceeds 10. Both reach about the same age, viz. 20 years. A similar difference is found to obtain between tame and wild cats, and between tame and wood pigeons." (Blumenbach, *Compar. Anat.* s. 341.)

I might have remarked formerly at p. 794. that the number of young depends on neither the frequency, nor duration of copulation, nor on the abundance of male semen: and at p. 721. that treble copulation is requisite to the generation of certain beings, for Sennebier declares some animalculæ to be endowed with so little sense of propriety that three individuals co-operate at procreation. See his translation of Spallanzani's *Opuscoli di Fisica Animale et Vegetale, &c.* p. lxxvi.

After some hours the germinal vesicle has left the surface of the yelk and is returning to the centre where it was originally, but whence it passed in the unimpregnated ovum to the surface. About the same time a vesicle arises from the germinal spot, enlarges speedily, and applies itself to the internal surface of the germinal vesicle. This new vesicle imbibes the fluid of the germinal vesicle: and the germinal vesicle in its new situation is finely granulous, less transparent, firmer, and of a yellowish brown.

The germinal spot soon moves to the centre of the germinal vesicle; exactly as the latter does to the centre of the yelk.

The fine membrane of the yelk after this suddenly thickens: just before the ovum leaves the ovary, and very often even during this change, the transparent membrane of the ovum imbibes fluid and distends, leaving a minute space filled with fluid between itself and the yelk ball.

These changes render it probable that the ovary in mammalia is the seat of impregnation: the spermatozoa actually penetrate "alive and active" to the surface of the ovary, according to the late observations of Professor Bischoff in the dog[f], and subsequently of Dr. M. Barry in the rabbit; though in 17 out of 19 cases the latter could not find them.

The peculiar granules or rather vesicles of the ovisac hang less tenaciously together, and often seem passing to a fluid state. Its tail-like appendages were distinctly seen continued into the four persistent retinacula, and evidently contribute to the same office. The retinacula, previously wrinkled, now enlarge.

Though most of these changes occur before the ovum leaves the ovary, some of the latter occasionally do not take place till it has entered the Fallopian tube.

Not the minute ovum, but the retinacula and tunica granulosa, outside it, are the parts which, besides their offices mentioned *suprà*, p. 790., present a surface to be acted on by the vis a tergo which expels the ovum from the ovary: and the vis a tergo is produced by the exuberant growth of a reddish fleshy mass which acts through the medium of the fluid of the Graafian vesicle. The retinacula and tunica granulosa are discharged with the ovum, render its escape gradual, perhaps facilitate its passage into the Fallopian tube, appear to be the bearers of fluid for the immediate imbibition of the ovum, and probably enter into the formation of the chorion.

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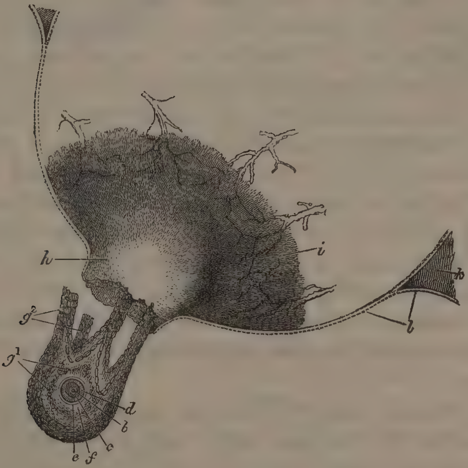
[f] *Lehrbuch der Physiologie*, I. Leipsig, 1839.

When the discharge of the ovum is very near, the portion of the Graafian vesicle that is directed outwards is seen to have been removed, so that little remains to arrest it but the peritoneum; and this gives way the last. The Graafian vesicle was formerly (p. 789.) shown to consist of the true ovisac and of a covering gradually formed. The latter has now become thick and very vascular.



am, Amnion.
amf, Union of the membranes *am*, and *f*.
bb, The true germ.
bb 1, Central portion of the germ.
bb 2, Future vascular lamina of the umbilical vesicle.
cho, Chorion, subsequently villous.
d, Yelk.
f, Thick transparent membrane of the ovarian ovum, — "Zona pellucida."
f 1, Fluid imbibed by the chorion.
g 1, Tunica granulosa.
g 2, Retinacula.
h, Ovisac.
i, Proper covering of the ovisac, — Corpus luteum : *h i*, Graafian vesicle.
k, Stroma, or substance of the ovary.
l, Peritoneum.

These references apply to this and the five following cuts.

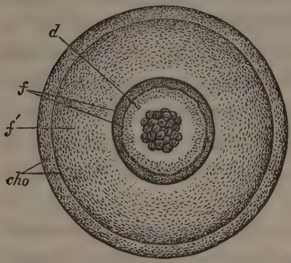
A few hours after the discharge of the ovum, the true ovisac may easily be squeezed out of its vascular covering, translucent, spherical, with the margin of its ruptured orifice bloody, its diameter less than half a line. If no pressure is applied, and the examination is deferred for a few days, the ovisac is not to be found, whether expelled or entirely obscured: from the centre of its vascular covering a mamillary process projects: and this vascular covering becomes the corpus luteum.

Many ova, both mature and immature, disappear at this time by absorption. The yelk of the mature liquefies, and first around the germinal vesicle; the germinal vesicle collapses, and does not, as after impregnation, return to the centre; the germinal spot breaks up; the zona pellucida becomes thin and distended with fluid, but its imbibed fluid mixes with the yelk, which it does not after impregnation; the proper membrane of the yelk does not thicken and is not even visible; the tunica granulosa and retinacula liquefy and leave the ovum uncovered. The yelk becomes at once a colourless fluid, whether the ova are mature or immature, and not nearly black from myriads of minute granules and oil-like globules, as in ova absorbed before copulation. Some of the larger unbroken Graafian vesicles, which the number of discharged ova forbid us to suppose intended to discharge, contain a large quantity of blood.

In some animals minute ovisacs are found in the infundibulum or large end of the Fallopian tube, discharged probably by the rupture of large Graafian vesicles in whose walls or neighbourhood they had been situated.

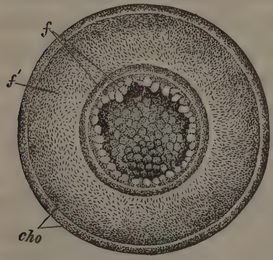
The discharged ova generally lie very near each other in the Fallopian tube. They seem stationary for some time at the commencement of the uterus, — within half an inch or an inch of the Fallopian tube.

The ovum enters the uterus in a state very different from that in which it left the ovary. 1. An outer membrane — the chorion becomes visible. For Dr. M. Barry confesses himself to have been mistaken in supposing that the thick transparent membrane called zona pellucida and furnished in the ovary is the chorion (*suprà*, p. 785. sqq.) On crushing an ovum of 41 hours, and about an inch from the infundibulum of the Fallopian tube, a thin membrane is found closely investing and rising from the transparent zone. This is the chorion. It at first imbibes fluid, by which it is for a time separated from the zone. Then the fluid passes into the interior of the ovum, and the chorion is again in contact with the transparent zone from which it rose. 2. The proper membrane of the yelk[g], which had suddenly thickened, disappears by liquefaction: so that the yelk is immediately surrounded by the zone. 3. Several large and very transparent vesicles form in the centre of the yelk and successive sets of these appear, smaller and smaller, till the centre of the ovum is mulberry-like. Each vesicle has a pellucid nucleus, and each nucleus a nucleolus.



There is no fixed relation between the size of the entire ovum and the degree of developement of its most essential parts: ex. g. the embryo may be far larger or far smaller proportionally to the ovum in some of its parts than in others. Nay, no two parts necessarily keep the same pace: ex. g. the umbilical vesicle may be far behind the advance of the embryo.[h]

In the uterus, a layer of vesicles of the same kind as those of the last and smallest set here mentioned makes it appearance on the whole of the inner surface of the membrane which now invests the yelk. The mulberry-like structure then passes from the centre of the yelk to a certain part of that layer, (the vesicles of the latter coalescing with those of the former, when the two sets are in contact, to form a membrane,—the future amnion,) and the interior of the mulberry-like structure is now seen to be occupied by a large vesicle containing a fluid and dark granules. In the centre of the fluid of this vesicle is a spherical body, composed of a substance having a finely granulous appearance, and containing a cavity filled with



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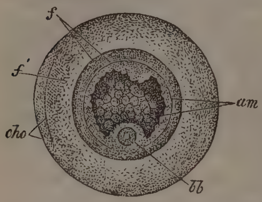
[g] Dr. M. B. retains the word yelk to signify the contents of the ovarian vesicle, within the ovisac, and around the germinal vesicle, but doubts the analogy implied by it.

[h] See *suprà*, p. 928. sq.; *infrà*, pp. 956. 983. sq.

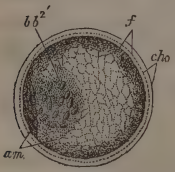
a colourless and pellucid fluid. This hollow spherical body seems to be the true germ; unless it were more correct to regard the vesicle with all its contents as the germ. The vesicle containing it disappears, and in its place is seen an elliptical depression filled with a pellucid fluid. In the centre of this depression, is the germ, still presenting the appearance of a hollow sphere.



"The germ separates into a central and a peripheral portion, both which, at first appearing granulous, are subsequently found to consist of vesicles. The central portion of the germ occupies the situation of the future brain, and soon presents a pointed process and resolves itself into vesicles, disposed in layers." "This process becomes a hollow tube, exhibiting an enlargement at its caudal extremity, which indicates the situation of the future sinus rhomboidalis" of the spinal chord. We have already seen that the foundation of the vascular system also is part of the primordial germ.

"Up to a certain period new layers come into view in the interior of the central portion of the germ, those previously seen being pushed farther out." It is by these layers that a structure is produced having the form of the central part of the nervous system. Possibly, there is not a separation into a central and peripheral portion, but the spherical body in the centre of the vesicle seen in the interior of the mulberry-like structure disappears by liquefaction, and a linear trace, corresponding to the "primitive trace" of authors on the bird arises in its place.

"From the region occupied by the germ there issues a hollow process, which by enlargement is made to line the inner surface of the ovum, — that is to say the inner surface of the membrane entering into the formation of the amnion and corresponding to the 'serous lamina' of authors; and the process now lining it represents an incipient state of the subsequently 'vascular lamina' of the umbilical vesicle, — a structure continuous with the structure corresponding to the 'area vasculosa' of authors on the bird.

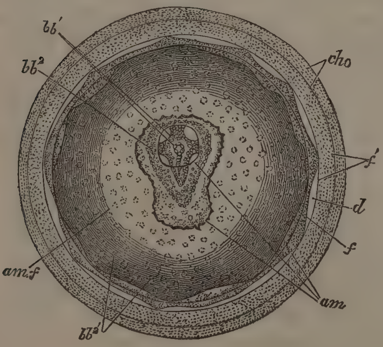


"There does not occur in the mammiferous ovum any such phenomenon as the splitting of a germinal membrane into the so called serous, vascular, and mucous laminæ.

"Nor is there any structure entitled to be denominated 'germinal membrane'; for it is not a previously existing membrane which originates the germ, but it is the previously existing germ which, by means of a hollow process, originates a structure having the appearance of a membrane.

"The structure entering into the formation of the amnion is no part of that which constitutes the embryo. The first appearance of the amnion is in the form of an epithelium—an epithelium-like layer of vesicles on the inner surface of the zona pellucida, to which the mulberry-like vesicles are subsequently added, and with which they coalesce. From the delineations of authors it appears to be a corresponding structure, which in mollusca is the foundation of the shell, and in crustacea and arachnida that of the outer covering of the abdomen."

"The ovum may pass through at least 21 stages of developement, and contain, besides the embryo, four membranes, one of which has two laminæ, before it has itself attained the diameter of half a line; a fifth membrane"—the proper membrane of the yelk while the yelk was incipient, "having disappeared by liquefaction within the ovum." The four membranes are, if we examine from without inwards, 1. the chorion, within which is imbibed fluid, and within which again is the yelk, escaped from its membrane but not mixed with that imbibed fluid; 2. the thick transparent membrane — zona pellucida, of the ovarian ovum; 3. the amnion; 4. the subsequent vascular lamina of the umbilical vesicle continuous with the peripheral portion of the embryo, having a lamina internal to it, and originating in the hollow process described as shooting out from the region of the germ. The lamina internal to it forms immediately after the hollow process is sent off from the germ,



and enlarges so as to contain the yelk: whether it is the foundation of the mucous lamina, or contributes to the foundation of the lamina subsequently vascular, or to that of both, Dr. M. B.'s observations have not enabled him to determine.

"With slight pressure the ovum, originally globular, becomes elliptical. Its tendency to assume the latter form is referable chiefly to a property of the chorion, and seems to be in proportion to the size of this membrane," so that it is obvious in those chiefly which have reached the uterus.

The proportion of ova in the uterus that appeared aborted was about 1 to 8. They were much smaller than other ova of the same period, and some had no chorion. The ova still in the ovary all exhibited the healthy appearance.

Dr. M. Barry's researches confirm the statement which I made p. 862. sq., of every animal and vegetable, if not of every organ, springing probably from a closed cell or vesicle. The vesicle is formed on a previously existing nucleus, which again often contains a nucleolus. The peculiar granules of his first paper are vesicles: and were represented by him with nuclei and nucleoli, though he was then ignorant of their importance. The vesicles constituting the outer portion of the mulberry-like structure of the present paper present each a nucleus and nucleolus. The vesicles composing the layer called amnion on the inner surface of the zona pellucida have each their nucleus and nucleolus. The yelk globules are true vesicles, containing other vesicles. The villi of the chorion appear very early and are vesicles in which are objects having the appearance of vesicles. The whole embryo indeed is composed of vesicles, and even the primordial germ itself seems to have been the nucleus of the vesicle in which it lies.

Schwann has demonstrated that all elementary parts, however different physiologically, have their foundation in cells formed on nuclei, by modifications of which muscular fibre, nervous tube, blood-vessel, or whatever else, is produced.

Dr. M. Barry at length proved his suspicion that the successive groups of vesicles were produced in the ovum while in the Fallopian tube by two or more infant vesicles arising in the interior of each vesicle, the parent vesicle always disappearing by liquefaction: each infant vesicle in its turn becomes the parent of others within itself, and then liquefies, till the mulberry-like clusters are produced. The germinal vesicle is probably an infant internal vesicle of the zona pellucida. Since the proper and temporary membrane of the yelk forms around the yelk, as its nucleus, just as in other situations a cyst, cell, or vesicle form around a nucleus; and since the germinal vesicle exists before the granules and globules of the yelk that collect and perhaps form around the germinal vesicle; the yelk may form around the germinal vesicle as its nucleolus. The germinal vesicle probably arises from the germinal spot seen on its interior, just as the original cell of vegetables is shown by Schleiden (quoted *suprà*, p. 862. sq.) to arise from a nucleus which he denominates from its purpose *cytoblast*. Within the proper membrane of the yelk,—the parent cell, new vesicles arise, the interior of each of these presenting others. In plants Schleiden finds this origin of vesicle within vesicle to be perhaps universal: but in the formation of animal tissues Schwann finds it rare: Schwann's observations, however, refer to a period later than that investigated by Dr. M. Barry. Vesicles which are formed within vesicles may form around portions of the contents, as around nuclei, in the same manner as perhaps the outer membrane of the yelk forms around the yelk, the yelk perhaps around the germinal vesicle, and the germinal vesicle perhaps around the germinal spot.[i]

The early separation into one part which is the foundation of the nervous system and into another which is the foundation of the vascular shows that division into forms takes place before there is a perceptible distinction of tissues: thus elucidating "the fact that parts in different animals, having a general resemblance in form, are sometimes the seat of very different functions. And if the primordial germs of organised beings in general resemble one another in appearance," "it is not surprising that there exist resemblances in the subsequent forms of beings more nearly allied." The mammal germ and vesicle curiously resemble the cytoblast of a cryptogamous plant (Rhizina lævigata) as figured by Schleiden. The foundation of man himself is a cell, vesicle, or sac,—a sort of hydatid; and this imbibes nourishment like an hydatid.[k] Nay, the embryos of many mollusca, as well as the germinal granules of some polypes, perform rotatory motions: even Leeuenhoek noticed these in the yelk ball of some animals nearly a century and a half ago (1695), though without exciting much attention till Carus and E. H. Weber published their observations within the last few years: and Dr. M. Barry actually once found, among certain vesicles which he often saw under the mucous membrane of the rabbit's uterus, one, having on its inner surface a layer of elliptic granules (vesicles) and containing a pellucid fluid, in the centre of which was an object, resembling the mulberry-like structure containing the primordial germ, already described, of the mammal ovum, and *revolving round its axis*. The revolutions were in the vertical plane; and always in the same direction; sometimes rapid, sometimes nearly suspended. They lasted half an hour, and then ended rather suddenly. In a few seconds the mass assumed a tremulous motion, which, interrupted for a few seconds by a renewal of the revolutions, continued for about 15 minutes. Afterwards it was broken up by force, and some of its parts, still hanging together, presented a renewal of the tremulous motion. Ciliary motions were very vivid on the mucous membrane in which the vesicle lay, but none were visible on the revolving object. The rabbit had been killed an hour and a half before the examination was begun. Though Dr. M. Barry witnessed this rotation but once, he has not particularly sought for it, and has frequently seen the same mulberry-like mass in these vesicles; and the vesicles of the mass itself have repeatedly exhibited the tremulous motion, which in one instance was comparable to that of separate globules in the neighbourhood of cilia in motion. Whether the mulberry-like structure with its germ in a mammal ova rotates, is yet to be discovered.[1]

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[i] See Schwann's *Mikroskopische Untersuchungen*, &c.

[k] See *suprà*, pp. 853. 862. sq., 934.

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[1] I cannot refrain from expressing my admiration of Dr. M. Barry's two papers. With his very existence I am acquainted solely by them. But he deserves to be held up as a rare combination of intense love of truth, indefatigable industry in learning from others and searching into nature herself, high intelligence, perfect conscientiousness in regard to the merits of others, and rational modesty. Let me intreat the student to imitate him in all these points. Some fancy that intellect scorns plodding: but the highest geniuses who have been successful have always been hard workers; — the dullest man may work hard, but so must genius if it will do great things. Some mistake worldly and temporary applause — the applause of those who are not able to appreciate, such as the trumpery firework-like blaze of a large practice, not necessarily ending in more than silence and darkness, for honour: but the honest and ardent investigation of truth is far, far higher happiness and secures permanent applause, — that only which a sensible person can desire, and which he will after all value less than

As soon as the fœtus is driven forth from its mother into the world it breathes, and then begins to cry. The placental circulation has for some time grown weaker and weaker; the lungs have been more and more perfected: the compression of the chord and the partial separation of the placenta obstruct the blood in the fœtal umbilical arteries, and thus in the aorta, so that it is inclined to pass more to the lungs, through the canalis arteriosus, than into the aorta. The chemical changes being impaired, the blood must find difficulty in passing through the lungs, and the want of respiration be felt.[m] Still the facts mentioned above, at page 214. sq., render it probable that the ordinary exciting cause of the first inspiration is the impression of the cool air upon the surface; and this alone will bring on respiration, should a child be born at 7 months, — that is, before the placental circulation has declined or the lungs been perfected and when the circulation is going on vigorously through the chord. But the child must have a certain amount of excitability to be so impressed. It may not breathe till slapped, rubbed, suddenly wetted with cold water, or subjected to a stronger stimulant than cool air. Irritation of the surface by mechanical means, while the fœtus is still enclosed in its membranes, will cause respiratory efforts. That the want of chemical changes simply is not so important before respiration

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the merit which gives rise to it. Some who even are intelligent and industrious, and successful in cultivating science, are unhappy unless they fancy themselves valued above others, and are constantly attempting unjustly to lessen the credit of others and setting forth their own merits: but such persons are unhappy; they are not alive to the superior joys of obtaining truth for its own sake above those of applause, they are not alive to the serene comfort of doing justice to our fellow men, nor to that of duly estimating ourselves, and of being thankful, and not vain, when it is certain that in some particular we are superior to another person. Those men of science, who in their passion for applause rob others, are infinitely worse than common thieves; for no combination can be more lamentable than that of acquirement or talent with baseness or even meanness.

[m] See *suprà*, p. 227. sq.

has once begun, is shown by the facility with which puppies and kittens live without respiration if taken from the womb under water.[n] When the growth of the fœtus is nearly accomplished, the instinct to breathe appears to be generated, just like that of sucking; so that irritation of the surface within the membranes causes a degree of respiratory effort. Osiander has observed the mouth to open and shut, and the diaphragm to rise and descend, in fœtuses expelled in their membranes; and even while he was performing the obstetric operation of turning. These efforts, no doubt, generally are made during the contractions of the womb in labour by healthy children in which there is no cause of inactivity, but are almost always necessarily fruitless till the fœtus comes into the air. Not only old writers, however, but moderns, as Professor Osiander[o] and other German authors, declare they have heard the child cry during labour, after the membranes were ruptured, but while the head was still in the vagina or still in utero with its mouth near the os uteri. Under peculiar circumstances, its cries are said to have been heard (*suprà*, p. 930.[p]) in the last days of pregnancy, before the commencement of labour. Portal was thought to have proved that the right lung inspires the first[q]; but, since the establishment of auscultation, Mr. Jowitt declares that the respiratory murmur may be heard equally in both lungs immediately after birth.[r] The upper portions, being nearer the trachea, respire sooner than the inferior. When once respiration has occurred, the lungs and thorax acquire a degree of expansion which they never lose. Bernt[s] states that before respiration the transverse diameter of the chest is from 2½ to 3 inches, but, after it has once begun, from 3 to 4½ inches; the antero-posterior diameter from 2 inches to 2½ before its commencement, but from 3 to 3½ inches afterwards: and that the diaphragm reaches the fifth rib before respiration, but never reaches higher than the sixth rib after respiration has once begun: whereas inflation of the chest after death produces no permanent enlargement of the cavity. After the first inspiration, the epiglottis no longer lies immediately upon the glottis; and the glottis becomes more open: the trachea grows permanently wider, the folds at its posterior part are effaced, and the transverse muscles which unite the two extremities of its cartilages become permanently tense: the left bronchia becomes more oblique and situated nearly as forward as the right. The lungs experience the greatest change, becoming permanently distended and absolutely heavier; but they become specifically lighter, and, though previously they sank in water, they now swim, crackle under the finger, and give out bubbles of air if pieces of them are pressed under water; and they still swim, whatever pains be taken to deprive them of air, whereas, if they have been inflated artificially, they may be sufficiently deprived of air to sink again. The freer entrance of the blood into the pulmonary arteries from the enlargement of the chest, and from the impediment to its flow into the descending aorta by the canalis arteriosus, since the umbilical arteries are obstructed, adds to the bulk and absolute weight of the lungs; so that, if previously they displaced 17·10 cubic inches of water, they now displace 33·10 cubic inches, and, if their previous weight to that of the whole body was as 1 to 60, it now becomes as 1 to 45 the first day, 1 to 41 the second day, 1 to 37 the third day, and 1 to 38 the fourth day: their absolute weight being in girls from 8½ to 14½ drachms, in boys from 9 to 16 drachms, before respiration, and gaining 6 drachms in the former and 7 in the latter by inspiration.

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[n] See Haller, *El. Physiol.* t. iii. p. 225.
Buffon, *Histoire Naturelle*, t. ii. p. 44.
Roose, *Physiologische Untersuchungen*, p. 66. quoted by Burdach, § 50.

[o] *Handbuch der Entbindungskunst*, t. i. p. 660. sqq. Burdach, § 506.

[p] See a case in the *Ph. Trans. abridged*, vol. xi.

[q] *Hist. de l'Acad. des Sciences.* 1769. p. 549.

[r] Dr. James Johnson's *Med. Chir. Review.*

[s] *Handbuch der gerichtlichen Arzneikunde*, p. 248.

The air contributes very much more than the blood to their enlargement, and the blood very much more than the air to their increase of weight. Before respiration the lungs were solid and of a dark red like liver, and presented hundreds of small lobules: they now become spongy, more of a vermilion colour, with points and striæ of the hue of cinnabar, and each lobule is seen to consist of four still smaller, on which capillaries full of blood are spread, giving it the appearance of a red marbling on a white ground. After artificial respiration in a still-born child the vesicles necessarily remain white, and this renders it difficult to discover the four lobules of which each consists. I before stated that respiration and its effects are not at once universal throughout the lungs, and therefore some parts of them still sink and exhibit the other characters of the fœtal organ, while others swim and are changed. If a child has breathed but faintly and died soon, a sufficient portion of the lungs may not have been inflated to support the rest in water. Torres declares this to have been observed at the end of twelve days from birth.[t] Inflammation or solidification of a portion of the lungs may at any age cause them to sink in water.[u]

As soon as respiration occurs, the blood of the right ventricle rushes into the expanded lungs and no longer into the descending aorta, which is now supplied by the ascending aorta only that proceeds from the left ventricle and receives blood purified in the lungs. From the placenta no longer attracting blood to itself, since it perishes by parturition, and from the blood now streaming freely to the lungs and rendering it useless, the course of this through the umbilical arteries declines; so that in perfect children their pulsation is at an end in a few minutes, although, in those which die prematurely and in which the pulmonary circulation therefore does not continue, their pulsation may last above an hour. When these pulsations cease, respiration may be presumed to be complete, and the chord may be tied: should this be done before they have ceased, the imperfect respiration may be insufficient for the purification of the blood, and asphyxia may take place: and, should the chord be divided and not tied, there may be fatal hæmorrhage.

The inflation of the lungs causes the heart to be pushed to the left by the larger right lung, and also downwards; and the superior vena cava is thereby lengthened. As the inferior vena cava descends with the diaphragm, the valve of Eustachius is drawn downwards, and thus no longer directs the blood towards the foramen ovale, and soon wastes: the hepatic veins, which before respiration opened near the foramen ovale and poured their blood almost horizontally into it, now become more distant from it and open more obliquely into the cava: besides which circumstance the inferior cava furnishes less blood, as it no longer obtains a supply from the umbilical vein: and the valve of the foramen ovale, situated in the left auricle, is now pushed back by the large quantity of blood passing into this from the lungs, and closes the opening. When sufficient time has elapsed for all the blood of the right ventricle to pass into the lungs so that the left auricle acquires a preponderance, which previously it had not, over the right auricle, the valve is firmly pressed against the opening, allows no blood to pass from the right to the left auricle, and becomes adherent by fibrin to the sides of the foramen. Usually its adherence is accomplished about the end of the first year; but the time varies, and the foramen not very rarely remains open for life. The right ventricle, thus receiving more blood, comes not only to equal but at length to surpass the left ventricle in capacity, and its coats become thinner and thinner.

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[t] *Mém. des Savans étrangers,* t. i. p. 147. sqq.

[u] Besides Blumenbach's references on those points at p. 845. in connection with State-medicine, see Dr. Beck, *Elements of Medical Jurisprudence.* London, 1825.; Dr. Hutchinson, *A Dissertation on Infanticide.* Ed. 2d. London, 1821.

From the blood flowing so freely into the expanded lungs and the descending aorta receiving so large a supply from the ascending, the canalis arteriosus is obliterated; and earlier than the foramen ovale. Its obliteration necessarily proceeds from the aorta towards the pulmonary artery. Before respiration it is nearly as large as the pulmonary artery, and much larger than any of the branches of the latter; but it becomes conical, some say after the very first inspiration, and much smaller than the pulmonary artery; on the third day it usually contains a coagulum, which in two months is converted into a fibrous chord. From the descent of the heart and the ascent of the arch of the aorta after the lungs are once inflated, the canalis arteriosus is instantly lengthened, and no longer lies horizontally, but makes an angle with the aorta: and it is moreover now compressed by the dilated left bronchia lying below it.

The umbilical arteries shrink a few days after birth, and at the end of about three weeks become fibrous chords, permeable at their origin only below the bladder.

The descending aorta, now receiving all its blood from the superior, ceases to be larger below than above the opening of the canalis arteriosus; and, as its blood is now all decarbonised and oxygenated, and it parts with none to the umbilical arteries, its ramifications to the pelvis and lower extremities enlarge, and the lower half of the system begins to grow rapidly and equal the upper.

The umbilical vein is shrunk and empty on the second or third day, and about the end of the second month is converted into a fibrous chord. It is obliterated first near the inferior cava; and this in consequence diminishes, while the pulmonary veins, on the other hand, increase. The liver not only descends, but grows proportionally smaller from receiving so much less blood, and loses its depth of colour.

The whole system becomes more animated from the higher purification of the blood in the lungs, and the more complete filling and emptying of the heart's cavities, and consequent force of the circulation.[x]

The liver at first retains its great proportional size, though it receives much less blood. As this fluid is now highly carbonised, bile is secreted abundantly; and from the profusion of bile, jaundice is common.

After birth, changes continue in the composition and amount of every fluid and solid; in the shape, size, consistence, and hue of all solid parts, and consequently in the vital properties and in the functions of every organ; and, in consequence of the changes of the brain, the mental character changes equally with the corporeal. All organs improve, though not simultaneously or proportionally, till their perfection is attained, and then all deteriorate till the system is good for nothing and perishes.

The changes after birth have been variously classed into periods. Leonell[y] divides human life after birth into two: Zacchias says it may be divided into twelve, since those who divided it into ten gave seven years to each division, and thus terminated with the age of seventy, to which two stages more must succeed, — extreme old age and decrepitude. Intermediate divisions into three, four, five, six, seven, and ten, have been made by others. Seven, which is equidistant from two and twelve, — the extremes, and neither too comprehensive nor too minute, is perhaps the most convenient, was made by Hippocrates and Proclus, and adopted by Zacchias, the most sensible and learned writer on this point of *State-medicine*, as well as by many other medical writers, and by Shakspeare[z], who, in remarking that "man in his time plays many parts," adds "his acts being seven ages." These divisions may be into Infancy, Childhood, Boyhood and Girlhood, Youth or Adolescence, the first and second Adult Period, the first or green Old Age, and the second or Decrepitude.

[x] Greater minuteness on these points may be found in Burdach, whom I have followed.

[y] *De Hominis præced. Quæst.* 5. art. 3. See Zacchias, *Quæst. Med. Leg.* I. 1. 2.

[z] *As You Like It*, Act ii. sc. 7.

1. Infancy (in and fari) extends from birth, when there is imperfect speech or none, and the young creature is "mewling and puking in the nurse's arms," to the end of the first dentition,—about the second year.

2. Childhood, from the end of the first, to the end of the second dentition.

The commencement of infancy is a sudden revolution; all having proceeded before in a purely vegetable manner. Now the being is suddenly insulated, suddenly becomes conscious of its own existence, feels hunger and want of breath, external temperature and mechanical contact, and exerts its will to indulge its inclinations. It breathes, it cries, it sucks, and moves its head, body, and limbs at pleasure. Great functions suddenly begin in its head and chest, and the functions of its abdomen suddenly become great. Its organs were all ready, but the means of excitement have been suddenly supplied. Still it is weak and helpless; can neither stand, nor sit, nor even hold up its head: and, though insulated, is perfectly dependent. It still requires a secretion afforded by another's system, and requires this to be brought to it; it requires others to keep it warm, to protect it from injury, to keep it clean, and to tend it in every way: and I suspect, for reasons which I shall hereafter give, that a living influence was communicated to it in utero, by the maternal fluids which entered into its system, and by the surrounding body of its mother in whom it lay, and that, after birth, a living influence is communicated of the highest importance in the milk poured into its system directly from its mother's breast without the intervention of a moment for this to lose its vital properties, and by the contact of the mother when it is lying in her bosom. Not only do children generally die which are fed with milk that has stood in vessels after having been taken from the breast of a brute, and with vegetable matter, whatever care be taken of them; but chickens which are hatched and afterwards kept warm artificially, though their food is the same, and the utmost care be bestowed upon them, acquire size and vigour more slowly than those which have the benefit of the hen's nursing[a] and therefore the contact of her body.

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[a] Burdach asserts that almost all young birds brought up without the mother perish. (§ 515. II. 13°.) The thousands hatched at the Eccaleobion in Pall Mall disprove this.

There was an old idea that animal heat was different from common heat. The moderns argue that caloric is always caloric, and that therefore the wisdom of our ancestors in this matter was folly. But though caloric is always caloric, it does not follow that with it some other principle may not co-exist in animals and be communicated. I know a clergyman in Essex who has severe pains in his legs relieved by no other friction than with the hand of another, nor by any other warmth than that communicated to his lower extremities when sitting between two persons, as in a coach, in which he was struck with the discovery The aged David had good reason on his side, when he had a young virgin to lie in his bosom. The communicator of course loses in proportion, and therefore Dr. Copland declares he has frequently known children become weak and pale from sleeping with the aged.[b] The greatest foe of the church, therefore, cannot doubt the propriety of its order that a man shall not marry his grandmother. While a woman can bear children, she is in the prime of life, and therefore not in a state to derive vigour from her infant but to impart vigour to it. If old women bred, their nursing as mothers would probably be deleterious.

Though the human being remains longer in its mother, and goes through a more perfect incubation proportionally to his size than any other animal; yet he comes into the world more helpless than almost any other. Some brutes at birth can see, some are well covered, some can walk and help themselves to extraneous food, and there is no proportion in the advanced condition of the various organs and functions, nature here as every where taking delight in endlessly varying the same thing and the means of obtaining the same object; but he cannot move from his place, keep himself warm, avoid danger, or see, except to distinguish light from darkness, and that so slightly at first that he can look at the sun. When he wants any thing he cries, nature's purpose in this being that others may attend to him; for which reason children cry till they acquire a good amount of independence, as well as women, who also look to others for succour. The young has no particular instinct towards its mother; it seeks for and from others, and it becomes accustomed and attached to its mother just as to any other individual who may supply its wants. But a powerful instinct is provided by nature in the parents, and particularly in the mother. In proportion to the helplessness of the young animal in respective species is the facility of all means for its preservation and, if necessary, of parental love; and, in proportion to the necessity of self-dependence, is the developement of the organs which are respectively required. In different brutes, this instinct is confined to the mother or given to both parents; exists generally just as long as the young are dependent[c], after which the parent drives the young away; does not exist at all or may be spent upon the offspring of others: all according to the necessities of the young. In the human race parental love continues to the end of life, for the parent can benefit his adult offspring by the counsels of his longer experience and by the property which he has amassed. Forcible, however, as is parental love in the female, it yields to hunger. In besieged towns, when the stock of food is exhausted, women eat their children. Ants and other insects eat their larvæ when in want of food: sows and ferrets also eat their young if very hungry when they bring forth. To save their reputations some women will destroy their illegitimate offspring. But, with the exception of hunger, parental love is in most women the strongest impulse; stronger, probably, than love of life. In man it is generally less powerful than sexual desire; and Don Juan, when in danger of emasculation, exclaims —

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[b] "A not uncommon cause of depressed vital power is the *young sleeping with the aged.* This fact, however explained, has been long remarked, and is well known to every unprejudiced observer. But it has been most unaccountably overlooked in medicine. I have, on several occasions, met with the counterpart of the following case : — I was, a few years since, consulted about a pale, sickly, and thin boy of about five or six years of age. He appeared to have no specific ailment; but there was a slow and remarkable decline of flesh and strength, and of the energy of all the functions — what his mother very aptly termed a gradual blight. After enquiry into the history of the case, it came out that he had been a very robust and plethoric child up to his third year, when his grandmother, a very aged person, took him to sleep with her; that he soon afterwards lost his good looks; and that he had continued to decline progressively ever since, notwithstanding medical treatment. I directed him to sleep apart from his aged parent; and prescribed gentle tonics, change of air, &c. The recovery was rapid. But it is not in children only that debility is induced by this mode of abstracting vital power. Young females married to very old men suffer in a similar manner, although seldom to so great an extent; and instances have come to my knowledge, where they have suspected the cause of their debilitated state. These facts are often well known to the aged themselves, who consider the indulgence favourable to longevity, and thereby often illustrate the selfishness which, in some persons, increases with their years." (*A Dict. of Pract. Med.*, art. Debility.)

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[c] Many brutes will die for their young. The doe of the roe and deer will cause themselves to be hunted in order to draw off the dogs from the neighbourhood of their young: the lark will expose herself to a dog for the same purpose: and swallows dash into a house on fire to save their young.

> "For what is losing children, few or many,
> To cutting off one's hopes of having any."

But a large number of women I believe would leave their husbands rather than their little ones. Poets of all countries and ages have depicted the passion, but none more forcibly than Byron.

> "The love of offspring 's nature's general law,
> From tigresses and cubs to ducks and ducklings;
> There 's nothing whets the beak or arms the claw
> Like an invasion of their babes and sucklings;
> And all who have seen a human nursery saw
> How mothers love their children's squalls and chucklings."

As most persons in this country have derived their knowledge of Phrenology not from Gall's works, but second hand from Dr. Spurzheim or third hand from Mr. Combe, and many still more remotely from others, I shall not hesitate to extract what the Founder of Phrenology says of the natural history of the love of offspring.[d]

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[d] "The greater number of insects, fish, and amphibia, endeavouring to protect their young from external accidents, lay their eggs in a situation calculated for the exit of the young and where they may find food. The care of their posterity does not extend farther.

"In some species of these animals, the care of their young is more varied. Certain species of spiders carry their young upon their back, in a little sac which they never let fall except in the most urgent danger, and which they hasten to take up again as soon as the danger is past. Whoever has once destroyed an ant's nest must have seen with what ardour the ants collect their eggs and the larvæ to put them in a place of safety. Wasps and bees, which at all other times allow themselves to be watched without anger, become formidable to all that approach them when they have young. Who is not aware of the indefatigable activity with which they nourish, with what courage they defend, their young, with what eagerness they lick and caress them from the moment they have left their cells?

"In birds we find the same touching affection for their offspring. The more sad experience they have had of the dangers that threaten their young, the more

That this,—parental love[e], is a distinct faculty is proved from its bearing no proportion to any of the other faculties or to any

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care do they take to construct solid nests, and conceal and protect them. When they have perseveringly hatched their young, both parents nourish them with ex-

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[e] Gall, in whom was no trifling nor pedantry, was satisfied with the simple and appropriate term — love of offspring: but Dr. Spurzheim, without adding a particle to our knowledge, was not easy till he, a foreigner, had conceitedly coined for *our* language the sesquipedalian word, Philo-pro-genitive-ness. I know not the advantage of one long word over two or three short ones, — of portions of different words made into one of seven syllables — phi-lo-pro-gen-it-ive-ness, strung together like Byron's satirical expression carotid-artery-cutting-Castlereagh, over the four syllables of the separate words — Parental love or love of offspring. Besides, the word is illegitimate; for no good writers employ compounds of Greek and Latin words, or Greek and words of any modern tongue: this is left to unclassical Frenchmen and puffing English tradesmen. Words of the same language only can be legitimately compounded together. There is, indeed, no such Latin word as progenitivus or English word progenitive: so that he has actually coined another word from which to coin his grand compound. What, however, is most amusing, progenitivus or progenitive cannot signify that which is generated, but signifies that which has the power of generation. As destructiveness comes from destructive, which signifies not that which is destroyed, but that which has the property or tendency to destroy, and destructiveness means the power or tendency to destroy, and philodestructiveness would signify a fondness for what destroys; so progenitive would really mean that which has the power or tendency to generate, and progenitiveness would mean the power or tendency to generate, and philoprogenitiveness would signify fondness for the generator or parent and be synonymous with filial love. If any person should contend that philo-destructiveness would signify, not fondness for a destroyer, but fondness for destroying, even then he must allow that philoprogenitiveness must signify fondness, not for offspring, but for generation and be synonymous with amativeness. The proper word would be philoprogeny; but then Dr. Spurzheim, in his trifling and vanity, having absurdly divided certain faculties grouped by Bischoff in 1805 (*Exposition de la Doctrine de Gall.* Berlin, 1805.) as one of his three great divisions of the faculties (see *suprà*, p. 378.), into two — propensities and sentiments, and having absurdly resolved to give to the former and the former only the termination *iveness*, had to coin an adjective ending in *ive*, and then a substantive ending in *ness*; and ignorantly (*Phrenology*, vol. i. p. 157. Amer. ed.) fancied he was coining an adjective from progeny.

Dr. Vimont is as wrong as Dr. Spurzheim. Because hens sit on their eggs and rabbits tear the down off their breasts to make a bed before their young come into the world, he contends that the instinct cannot be mere love of offspring, and there-combination of them either permanently or occasionally in an individual. It may be naturally strong when they, one or more,

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treme tenderness, their watchful love foresees all the accidents to which they may become victims, instantly warns them of these, makes them remain quiet and hide themselves, or quickly conveys them to a place of safety. When the father and mother perceive that their nestlings are threatened, what uneasiness, what alarms they display, what stratagems they practise to deceive the bird of prey, the serpent, the weazel, or man! and, when the enemy succeeds in carrying off their young, what plaintive cries, what obstinate resistance! Sometimes, while uttering plaintive accents, they follow the spoiler to a considerable distance, even to the place where he deposits his prey, and never leave the spot till all hope of recovering their young is lost: even hunger will not compel them to quit their young in the moment of danger: frequently after long continued cold and wet, male and female are both found dead on the body of their young, which have equally perished with the cold.

"In the mammalia likewise, the love of offspring is the most active and imperious of all the instincts. The mother watches with solicitude and anxiety every thing that may be injurious to her young. As soon as the fox, the cat, the squirrel, &c. give the least sign that their place is discovered, they instantly abandon it and hide their young in another retreat. Birds of prey, however shy and wild they were previously, and whatever prudence they displayed in their neighbourhood before, become rash when they have young ones to support: no danger stops them: they penetrate without hesitation into gardens, yards, hen-houses, pigeon-houses, &c. When all the openings of a fox's earth are beset with snares, the animal if it have no young will stay within for a fortnight, till there is no alternative but to die of hunger or fall into the snare. But when they have young, the barbarous fox-hunter too well knows that the mother will not long resist the groans of her young, and that the father also, after having exhausted all the means of safety, will not hesitate to become the victim of his tender love for his offspring. Cats suckle the young of those whose mother is ill or dead. With what earnestness does the bitch implore the mercy of her master when taking away her young! The doe and she-goat forget they have no weapons, and rush blindly upon the enemy, when they have to save or defend their young. With what rage does not the wild sow defend her litter? How formidable do beasts of prey become, when they are searching for food for their young!

"Finally, who does not recognise this adorable inclination in the human race? From the most tender age nature makes the female perform the prelude to the part of a mother, and makes her pass through different degrees of instruction to prepare her for her future destination. Do you see this little girl so intently occupied in

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fore styles it the *love of the product of conception.* According to this nomenclature, the hen should love the emptied egg shells, and the quadruped and biped mother the placenta, as much as she does her little ones.

are naturally weak: it may be naturally weak, even be completely absent, when they are naturally strong: it may be highly excited,

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playing with her doll? She dresses it, undresses it, ornaments it; gives it to eat and to drink, prepares its night linen, puts it to bed, often takes it up, caresses it, gives it a lesson, scolds it, threatens it, tells it stories. It is thus that she passes the whole day, weeks, and months, with her beloved doll. She takes charge of those brothers and sisters who are younger than herself with a cordial kind feeling;—she feels their pleasures and their griefs more acutely than they themselves. Hardly does a new inclination develope itself in her heart than nothing appears in her eyes more precious and attractive than children. Where is the father, where is the mother, who does not recollect with ecstacy the time when, not being yet married, they hoped soon to be so? And, when the first indications appeared that their union was not barren, what delight! what mutual congratulations! what projects for the future! Some young women feel an inexpressible joy at the moment when they first perceive the movements of their conception. The young wife becomes the object of the eager cares of all the family, every one waits for the decisive moment with impatience and anxiety united. Is there a more pure happiness than that which is depicted in the looks of a mother watching with tenderness the wants of the little one which she presses against her bosom? What duty is more respectable and more sacred than the cares which married people take of the precious pledge of their love! If I had a city, an emblem of domestic love should be erected in the midst of it,—a mother suckling her child. As often as a grandmother sees her grandchildren and great-grandchildren, the sentiment of maternity springs up anew in her heart, and this beneficent instinct acts again when all the other inclinations are nearly extinguished in her soul.

" Every sacrifice, the least action, tending to save a child or secure its happiness, moves us deeply; everything that discloses the heart of a stepmother fills us with indignation and horror; every crime against feeble infancy, or against a woman with child, or against a mother who suckles, makes us revolt.

" The interest which childhood excites inclines judges in favour of the guilty. Galba Sergius, who, being accused of assassinating 30,000 Lusitanians, was to be banished, was absolved by the people, melted at seeing him shed tears and press two young infants against his heart.

" On reflecting upon everything which characterises the love of offspring, it is impossible to deny that it is an innate instinct and intimately inherent in the organisation.

" To prove that it is an innate and peculiar instinct, let us follow it in its different manifestations in different sexes, in different species, and in different individuals.

" In many species the male has little or no love for its young. Such are the bull, the horse, the stag, the wild boar, the dog, the cock. In these species the love of offspring appears to belong exclusively to females. It is rare to see a dog carry food to a bitch who has a litter.

" In other species, on the contrary, the male and female equally love their when one or more of them is inactive: it may be dull when any other is active.

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young and take care of them in common. This is especially the case with those in which nature has established a marriage as durable as life; for example, in the fox, the wolf, the marten, the polecat, in almost all birds, as the stork, the swan, sparrow, the merlin, the nightingale, the pigeon. In these species, when the female dies the male continues to hatch the egg and nourish the young. While both are alive, they usually sit on the eggs alternately and take care of the young in common.

"However, even in these species we remark that the female possesses this instinct more powerfully than the male. In imminent danger the father flees sooner than the mother.

"In every one of these classes there is a difference between individuals. There are cows, mares, bitches, which bear the loss of their young with much indifference; some females even abandon their young as soon as brought forth. Pigeons, both male and female, generally sit upon their eggs carelessly. They often allow their eggs to cool; they often crush their young ones; sometimes they abandon their nests for the slightest reason; and, if their young ones are taken from them, they do not express much regret. The king of quails sits with such assiduity that its head is frequently cut off by the scythe of the mower. When a building takes fire in which there is a stork's nest, the old birds precipitate themselves into the flames rather than abandon their young.

"The female of the silver rabbit and that of the hampster quit their young easily, and eat them sometimes even when they have plenty of food. Nothing is more original than the idea of M. Virey, when he maintains that females kill their young through maternal love, not having milk enough for them. If he would take the pains to compare the heads of such stepmothers rabbits, sows, and women, with the heads of good mothers of the same species, he would discover the true reason. Other females are inconsolable at this loss, grow thin with grief, and utter cries of lamentation. I have seen bitches seek their young ones for whole months incessantly with the most anxious restlessness, dart furiously upon every one whom they suspected might have taken them away, and load with plaintive caresses all those whom they thought they could depend upon to pity them and restore their young; and when they saw their hope defeated they would utter prolonged howlings. Some mares have such a passion for foals that they steal those of others and take care of them with a zealous tenderness.

"In the different species maternal love manifests itself with different modifications. The female of the silver pheasant loves its young remarkably, for which reason the nest and the management of young Guinea fowls are intrusted to it in preference to a Guinea hen. Certain females love their own young only and hate those of other females of the same species. The female partridge loves its own young with great tenderness, but pursues and kills those of others. The common hen pheasant, on the contrary, shows much less love for her young, and abandons with much indifference those which have wandered away, but receives with joy

By all these circumstances, Gall was the first to prove that it is a distinct faculty[f]; and, after extensive and laborious observation,

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young pheasants which are strangers to it. Some animals live a long time with their young and constitute a family; others quit them as soon as they can do without the aid of a parent.

" There are many families of insects, amphibia, and fish, neither the male nor female of which troubles itself about its young. Among birds, the cuckoo is entirely a stranger to the love of offspring. All its cares for its posterity are limited to its eggs, which it lays in the nests of other birds whose eggs it takes away or eats. The owners of these nests, always smaller than the usurper, not only hatch the egg of the cuckoo, but also nourish with indefatigable kindness the voracious young one which comes out of it. When the young cuckoo is taken from the nest and put in an aviary with other birds or exposed in a garden, all the birds which are able hasten to adopt it. I have many times caused a young cuckoo to be reared by a wren; it was a very amusing sight to see the nursing father obliged to get upon the shoulders of its nurse child to put nourishment into its beak.

" Man belongs to that class in which the male and female both love their young and take care of them in common. However, woman surpasses man in this respect. The instinct manifests itself from infancy; the little girl holds out her hand after a doll, as the little boy does after a drum or sabre. When a child has to be taken care of, a female and not a man servant is sent for. Females who do not wish to marry, or married women who are barren, often adopt the children of others, in order to bestow upon them the care which nature imposes upon a mother. All the physical constitution of a woman coincides with her moral and intellectual character, to prove that she is destined more particularly than man to take care of infancy.

" These striking differences in the manifestation of the love of offspring prove that it is not a voluntary or factitious inclination, but an instinct resulting from the organisation, varying with it, but always natural and innate." (Gall, l. c. 4to. t. iii. p. 140. sqq.; 8vo. t. iii. p. 419. sqq.)

[f] Before his time, some referred the love of offspring to general instinct, as though it was not an individual instinctive feeling; others explained it by saying that it was natural! others that a *mother* loves her child because it contributes to her happiness, is a part of herself, or of the man she loves, or was made by him, because she is fond of being a mother, because she has felt it move in her inside, &c. &c. (*Journal de l'Empire, et Dict. des Sc. Méd.* t. xxi. p. 210.) Even now Burdach (§ 515.) asserts that parental and sexual love are the same instinct. His argument is that the care of the young after birth is a continuation of incubation, and incubation a continuation of procreation. This is about the same thing as saying that hunger is identical with the desire of defecation, because defecation is continuous with digestion, and digestion with eating. He adduces as a physical proof the fact that some brutes call their young with the same note with which they call the male. Painting and music must therefore be the same, because they are both executed by the hand. This reminds me of an absurdity of Richerand, who says (*Nouv. Elém. de Physiol.* t. ii. p. 201.) that maternal love results not from

he established that it is seated in a particular part of the brain. Its situation is undoubtedly the posterior extremities of the posterior lobes of the brain.

The greater projection backwards of the superior part of the occiput in most women than in men puzzled Gall for many years, and was not accounted for by him in his lectures; and it was not till he noticed the same difference in all the male and female skulls of his collection that the true reason for this ordination of nature struck him. To suppose this not to be for an important purpose would augur stupidity: and all observation shows that in proportion to the developement of the portion of brain which causes the projection of this part, in species at large, in varieties, and in individuals, whichever be their sex, is the force of parental love. The man is to be pitied who can be interested with the mechanical purposes of the size and form of a lower jaw or thigh bone, and not be more excited by the size and shape of a particular part of the skull dependent on the form and size of the corresponding part of the brain, — the organ of the most wonderful of our functions, nor be anxious to learn Nature's reason for them. If the posterior extremities of the posterior lobes are large, and the cerebellum small, there will be intense love of the offspring, and great indifference to the other sex; and *vice versâ:* if they are large, and the sides of the head just above the ears also large, the being may be most ferocious, as the tiger and hyæna and the Carib [g], yet all devotion and gentleness to the

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any cerebral action, but takes its source in the bowels; — "*c'est dans les entrailles qu'il prend sa source.*" See Gall's refutation of such writers.

[g] The New Zealanders are remarkable for their love of war, their cruelty, revenge, deception, and thievery; yet Mr. Ellis mentions, in his *Polynesian Researches*, I. 26. that a chief, Tetoro, in setting out with him on an excursion, accidentally struck one of his little ones with his foot: "the child cried; and though the chief had his mat on and his gun in his hand, and was in the act of stepping into the boat, and the men were waiting for him, he no sooner heard the child cry than he turned back, took the child in his arms, stroked its little head, dried its tears, and, giving it to the mother, hastened to join us." Attachment is also intense among them. "The wife is not enjoined, as among the Hindoos, to devote herself on the funeral pile of her husband by any doctrine of the national religion, nor is it even expected that she should give such a proof of it; yet it is by no means unusual for her on occasion of her husband's death to commit suicide, in order that her spirit may follow his." (*Library of Entertaining Knowledge,* New Zealanders, p. 388.)

offspring, submitting to every privation and hardship for its sake: if they are large, and the love of property and the instinct to destroy life large, and the coronal surface low and sloping at the sides, a man may be the greatest villain and yet the most affectionate and tender father.[h]

The sticky liquor amnii and the vernix caseosa require to be washed off; the soft and highly coloured surface to be kept warm and in contact with what is soft; and food to be supplied. The young of all mammalia instinctively desires and seizes with its mouth the nipple of its mother or some other individual; and it soon falls asleep. It requires food very often, and in larger proportion than adults, and bears the want of it worse: it passes the chief part of its time in sleep, and, the more premature it is, the more does it sleep. It gapes much; and cries; and very frequently discharges the contents of its bladder and rectum. It at first takes no notice by the eye or ear: the functions of these organs are gradually established. The fine down which is seen upon the whole of its surface comes off; and the hair of its head grows pretty freely. The temperature of the infant and of all other new-born animals is lower than that of the adult, and they maintain a peculiar temperature much less, being more easily cooled and heated, and vitiating the air less, proportionally, than adults.[i]

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[h] It is lamentable to witness the ignorance of well-informed minds of the variety of faculties that constitute the mind, and their independence to a certain extent upon each other. In the *Examiner* newspaper, — a weekly real treat for men of liberal views and education, the mention of the phrenological organisation of the young murderer Marchant was sneeringly headed, "The amiable Master Marchant;" and a few Sundays afterwards (January 19. 1840.) it said, "In the fine qualities found in Burke, Hare, Corder, Thurtell, &c. there is nothing richer, &c. &c." What fine qualities were ascribed to Burke and Hare I cannot say. However, not only may parental love but attachment to parents and friends coexist with infamous qualities. Young Marchant was an affectionate son, in the midst of his wicked qualities. A dog is as innocent and playful as an infant to the master or the children whom he loves, but strangers and rats will see him in a very different light and give him a very different character. Shakspeare knew human nature better: —

"Oh! thou goddess,
Thou divine Nature, how thyself thou blazon'st
In those two princely boys! They are as gentle
As zephyrs, blowing below the violet,
Not wagging his sweet head: and yet as rough,
Their royal blood enchaf'd, as the rud'st wind
That by the top doth shake the mountain pine,
And make him stoop to the vale."

Cymbeline, Act iv. sc. 2.

Dr. Edwards discovered that brutes which are born with their eyes closed, or cannot at first walk about and procure food, or have not integuments sufficiently copious to preserve their temperature, are little warmer than the surrounding medium if removed from their nest or bed: but that they acquire about the fifteenth day, if quadrupeds, and about the end of the third or fourth week, if birds, the calorific power of adults. In all these the ductus arteriosus is generally large and open, and closes as the calorific powers increase. Upon its state, and not upon the circumstances first mentioned, does the temperature depend. As the calorific powers change rather suddenly, we must suppose the completion of the closure to be rapid.[k]

The human fœtus resembles these brutes in having the eye closed by the membrana pupillaris for many months, and children born before time long continue to require much artificial warmth. But, although the temperature of the very young is so easily lowered, the ill effects of cold are better recovered from than by adults.

Life also continues longer without respiration, or with a limited quantity of air, than in adults.

Le Gallois found that a rabbit 30 days old would live without air about the same time as an adult,—2¼ minutes: a rabbit 10 days old, 7½ minutes; one 5 days old, 16 minutes; and one a day old, 30 minutes.

Bohn mentions having seen two female infants alive who had been buried deep in the ground by their incontinent mothers and not dug up for some hours. He says also that, in 1719, a female infant was dug up alive after being buried for some time at its birth by the mother; and that in 1764, a new-born child was taken alive from a heap of straw, in which it had been placed, wrapped in several cloths by its inhuman parents, seven hours previously. Dr. James Curry has recorded a case, upon the authority of a surgeon of the Northampton General Hospital, of a child which was born apparently dead, and, on account of the attention required by the mother, put aside, and then carried by a woman to a wash-house, in the depth of winter. After two hours the surgeon inquired after the child, and by perseverance recovered it[l]: and this confirms my belief that many infant lives are annually lost from the want of perseverance in resuscitating measures.

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[i] Dr. Edwards, l. c. p. 165. sqq. See *suprà*, p. 240.

[k] l. c. P. iii. ch. i. and p. 618.

In regard to respiration only, if a stupor has been induced, or a peculiar nervous state exists (as mentioned at page 54. sq.), respiration may be dispensed with — I dare not guess how long.

The greater retention of life in the young was shown by Le Gallois, who found that the abstraction of the heart destroyed a rabbit 30 days old in 1⅓ minute; one 15 days old in 2¾ minutes; and a rabbit one day old not before 20 minutes.[m] Injuries of the brain also are borne better than at a later period. The irritability of the muscles was found by Le Gallois to last a quarter of an hour after the decapitation of new-born rabbits; and only two minutes after the decapitation of those a month old. These circumstances connect the cold and warm-blooded, and the hybernating and non-hybernating, animals. I mentioned, at p. 696., an analogous fact in regard to hybernating animals. When these are in their torpid state, they are far more tenacious of life as well as less susceptible. Mangili cut off the head and neck of a marmot in the state of hybernation in March, and put it in spirits: yet movements were evident in it at the end of half an hour, and galvanism produced strong contractions in pieces of voluntary muscles three hours after they had been cut off, and even four elapsed before their excitability was much diminished; the heart beat for three hours after decapitation. He made the same experiment in June with a marmot which had been out of hybernation two months: the muscles showed little excitability under galvanism at the end of two hours; and the heart ceased to beat in fifty minutes after decapitation. Such facts probably depend upon the low degree of the properties of the organs injured or removed, so that these have less power over the rest of the system; and upon the imperfection of susceptibility throughout the system, so that one part is incapable of greatly sympathising with another. The imperfection of susceptibility is shown in the common occurrence of all the children of a nursery labouring under an infectious disease, — measles, scarlet fever, or small-pox, except the baby. Susceptibility seems much less before respiration; for Herholdt states that animals are very little affected by galvanism before respiration, which, after its commencement, are affected violently.[n] In the imperfect state of insects, insusceptibility is very great. I have soaked a caterpillar in Scheele's prussic acid, and after a time it has begun to move again and been apparently as well as ever: but, when I held a fly over a small vial containing only a few drops, it stretched out its legs and perished. Infants, however, who of course must have breathed, are more easily affected by agents than adults; much smaller doses of narcotics and purgatives must be given them: yet they bear, proportionally to their age and size, larger doses than adults.

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[l] *Obs. on App. Death, &c.*

[m] *Expériences sur le Principe de la Vie*, p. 78. See also Braschet, l. c., and Lallemand.

Yet, notwithstanding this greater tenacity of life, external circumstances are so often unfavourable to early existence that a large proportion of new beings perish. Still-born children may indeed have perished before or during labour; but the proportion of still-born children to others, at Paris, during seven years, was as 1 to 19, and in London, as 1 to 30.[o] It is more frequent where there is more than one child. While in Dublin it was 1 to $20\frac{2}{5}$ among single children, it was 1 to $13\frac{1}{2}$ among twins.[p] Male infants are universally more frequently still-born than female, whether from their greater size, and greater want of support before birth, and their greater want of air, or, as Burdach suggests, from their greater vigour throwing them more frequently into unnatural positions and thus rendering delivery more difficult: and, in truth, Riecke[q] found that the number of instrumental deliveries among female children to male was as 1 to 1·40; and still-births in ordinary delivery as 1 to 31, and in instrumental as 1 to 2. During seven years at Paris, female births were to male as 1 to 1·05, and female still-born children to male as 1 to 1·29. In Belgium, of 2,597 still-born children, 1,519 were males, 1,080 females,—a proportion of nearly 15 to 10, while the male births to the female were as 15 to 14. In Prussia, from 1826 to 1831, the still-born males were 59,144, and the females only 43,533.[r] The proportion of still-births is greater among illegitimate than legitimate children, from the greater difficulties of the mother's situation.

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[n] *Commentation über das Leben*, p. 74.

[o] Guerson, *Magazin*, t. xiv. p. 419.

[p] *Phil. Trans.* 1786. p. 352.

[q] *Topographie von Wurtemberg*, p. 31.

Usually about one fifth of children die in the whole of Europe in the first year; and, though the proportion is various in different cities, and has diminished of late years, the number is larger as the age is less, and particularly in the first month; and the first week of the first month is more fatal than the second, and the second than the third: after the second week the mortality greatly lessens. Thus, in Belgium, out of 100,000, there died in the first month 9604; in the second but 2460; in the third 1761; in the fourth 1455; in the fifth 1149; in the sixth 1045; and but 833 on the average in each of the next six months; indeed a larger number perish in the first two weeks, than in any other of the first month: in Berlin the mortality was as 1 to 32 in the first week; 1 to 35 in the second; 1 to 106 in the third; and 1 to 124 in the fourth. During the whole of the first year a greater proportion of boys die than of girls, and of twin than of single children. From the difference of care, as is generally supposed, a larger proportion of children die who have wet nurses than of those whose mothers perform the duties of nature, and of illegitimate than of legitimate children. The compression of the head in labour, the much lower temperature of the air than the degree of 98 which they invariably enjoyed before birth, all the wants, vicissitudes, and mishaps to which the young are exposed, their feebleness of generating heat[s], their great want of food and repose, and their small energy, would cause even a far greater mortality, had they not a greater insusceptibility and tenacity of life than is enjoyed by adults. The defence of the infant against injury is passiveness and insusceptibility; the defence of the adult is energetic resistance.

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[r] Dr. Bellefroid, *Bulletin Belge*, 1839.

[s] Drs. Villeneuve and Milne Edwards found that, as infants in France are always carried to the mayor for registration a few hours after birth, most deaths occur among the new-born in winter, in northern and colder departments, and where the *mairie* is extensive so that the infants are carried to a greater distance. (*De l'Influence de la Température sur la Mortalité des Enfans nouveau-nés.*)

The crying at birth, probably from the disagreeable feeling of the cold and new medium, and perhaps partly from consequent alarm, drives the blood freely to the brain, which had been compressed and deprived of its proportion of this during labour, and to all other parts: and the increase of the heart's action, by respiration, now maintains a strong circulation, so that the brain and organs of sensation, and the digestive organs, are competent to active function, on the application of their respective external stimuli. Nutrition proceeds vigorously, and, as before birth, not merely do all parts grow, but change in their composition, and acquire new consistence, new hues, new structure, and thus greater and new powers. The sympathetic nerve has hitherto been proportionally more firm and dense than the nerves of sense and motion; but the latter gradually improve in these respects. The proportionate weight of the brain to the whole body, from being 1 to 8 soon after birth, gradually declines, till in the adult it is as 1 to 40 or 50; but its composition improves, it becomes firmer, the fibrous and pulpy substances become more distinct, and the yellow substance between the two diminishes. At birth, *according to Meckel* [t], "the cerebral trunk is still greyish; soon the corpora pyramidalia grow white; then the olivaria; at about the third month, the pons; after the sixth month, the crura cerebri and the medullary eminences;" agreeably, be it remarked, to Gall's assertion, that grey or pulpy substance precedes the fibrous.[u] The preponderance of the cerebrum

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[t] *Handbuch der Menschlichen Anatomie*, iv.

[u] After Gall had promulgated his views on this point, M. Richerand wrote as follows: —

"A circumstance very worthy of attention and upon which no anatomist has dwelt" (*Elémens de Physiologie*, 7th edit. t. ii. p. 127.), "is, that the brain of the fœtus and of the new-born child appears to consist almost entirely of a greyish pulp, insomuch that it is difficult to distinguish the medullary substance. Would it be absurd to think that the medullary portion of the brain is not perfectly organised until after birth, by the developement of the fasciculi of medullary fibres within these masses of greyish substance, which should be regarded as the common base from whence the nerves derive their origin, as their *matrix*, to use the expression of Dr. Gall? The almost complete inactivity, the passive condition, as it were, of the fœtal brain, are such that the existence in it of the medullary apparatus, to which the most important operations of the intelliover the cerebrum, that distinguishes the human from the brute organisation, is greater than in the adult; for the new-born infant's cerebellum weighs but as 1 to 9 or even 23 compared with the cerebrum, whereas it is as 1 to 5 or at the utmost 7 in the adult.[x] All parts, by degrees, receive less and less blood proportionally, and, assuming their destined characteristics, are less vascular, so that the brain receives less blood in its interior. The cornea and humours become more transparent; the aqueous humour increases and makes the cornea project more than *in utero*, where it was more like the cornea of an aquatic animal. At first the infant must see all objects confusedly; but gradually it sees well, though for a time it is near sighted: it hears well later. It gradually acquires more smell and taste, but for a long time readily takes things which, when it is older, disgust it. The nasal apparatus is very small at birth. Gall states that the nerves of smell and taste are usually developed earlier than those of sight and hearing, as well as in brutes which are blind and deaf at birth.[y] By the time it distinguishes individual things and parts, it grasps small objects; then recognises faces and voices; smiles and chuckles with delight if played with, and tosses about its head and extremities; instinctively distinguishes agreeable looks from frowns, and endearing from cross sounds of the voice; desires to possess all that is shown it, and cries and falls into a passion if disappointed. It tries to touch every thing, and puts all to its mouth. As its faculties spring up, so do their affections or modes, — attention, judgment, memory: and experience incessantly makes fresh acquisitions. As soon as a faculty springs up, there is a strong desire to exercise it: and there is a strong desire to acquire knowledge, — the curiosity of a child is boundless. It desires not merely to examine all objects, but to judge in every way, and have every thing explained, and proposes questions and objections which its parents often cannot answer. In the latter half

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gence appear confided, was unnecessary: its rudiments exist in the fœtus at its full term." "I intreat the reader," subjoins Gall, "to compare with this passage what *I* have said upon the subject in the first volume of *my* large work, already printed in 1809, in order to judge whether it is to M. Richerand that this observation belongs." (8vo. t. ii. p. 432. sq.; compare 4to. vol. ii. p. 408.)

[x] Gall, l. c. 4to. vol. iii. p. 92.; 8vo. t. iii. p. 255.; and *suprà*, p. 866.

[y] l. c. 4to. vol. ii. p. 406.; 8vo. t. ii. p. 429.

of the first year it begins to try to walk; it utters various sounds, indicative of its desires and feelings; and it endeavours to imitate those of others. Imitation is one of the most powerful and important principles in our nature, causing us to use a particular language, to dress, to live, to behave, nay, in a great measure, to think and believe, nationally and sectionally, if I may so speak, though we may fancy that in all these matters we act of our own most excellent free will and sound unbiased judgment, founded on positive knowledge. The force of imitation is immense in the young.[z] It soon compels the child to talk the language of those around, and do as far as possible all they do. Without this impulse, little advance could be made. With the impulse of imitation, there soon co-operates that of habit, and then that of belief. What we have done we do more easily, and moreover acquire an inclination to do again; and what we witness or have communicated to us by others, we gradually acquiesce in and are reconciled to, objection and repugnance declining by repetition of the facts or opinions, till ugliness may be confounded with beauty, vice with virtue, absurdity with sense, and what is proofless with what is certain. The disposition to believe is so strong in us that experience only of deception brings us to doubt each other. The child believes all it is told; and incessantly asks questions, necessarily believing that it will be told the truth. It soon may deceive others; but still it believes implicitly, till taught by experience that others must not always be believed. This disposition to believe each other remains through life, and without it social intercourse would be confusion. It is shown by our asking the way of strangers in the street, and in fact all day long; though experience of the bad feelings and of the ignorance of others prevents uniform belief. The importance of imitation, habit, and belief, must be far greater than the mischief. They enable us to act long before positive knowledge would qualify us: they produce uniformity of thought, action, manner, and language, among those who associate, so that there is peace comprehension, and co-operation. Their evils are the absurd or detrimental views and practices of individual nations, sects, or parties. But in man's natural progress, the understanding becomes more cultivated, and intercourse between sects and parties becomes greater. We are naturally impelled to effect every thing more easily and rapidly, and means of intercourse, whether by locomotion or signs, are advanced beyond all preconceived views of possibility, and thus the distance between individuals and nations becomes a trifle.[a] Hence each sees many things that it considers indispensable dispensed with by others advantageously; each sees many things effected better by others; one avails himself speedily of the improvements of another, in doctrine, conduct, and all matters of science and arts, and the narrow sectarian wretchedness of mixing but with one party is more and more broken down. Thus are the evils of imitation, belief, and habit at length corrected. Experience is enlarged, and judgment better exercised; all are brought more to think for themselves, — that is, to become less and less the slaves of narrow imitation, habit, and belief. Now each child, though it thinks and acts chiefly through these three impulses, advances more and more in experience, and in disposition and power to judge. It questions and objects; and at length begins to think considerably for itself, though the greater part of mankind are, in the immense majority of their opinions and doings, still the unconscious slaves of imitation, habit, and belief, through the defect of sound education and the narrowness of their reading and direct intercourse.

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[z] See my *Essay on the Physiology and Pathology of Imitation*, read to the Phrenological Society, in the *Lancet*, 1827, No. 190.

While experience and knowledge enlarge, and judgment becomes more exercised and riper upon some things, and various passions are felt, the composition and structure of the various cerebral parts ripen, and their size increases, so that the faculties become stronger, and more and more able to avail themselves of experience.[b] Not only colour, but music, becomes appreciated, and all the faculties of the lower and higher frontal region are displayed; benevolence, veneration, attachment, courage, cunning, violence (destructiveness), love of praise, pride, &c. &c. are felt. Very young children manifest more or less of these, and they manifest more and more of each according to their individual nature. It is amusing to see the cunning, fury, and vanity of the little creatures gradually develope. The facts acquired by the external senses have been viewed as the causes of these faculties, whereas they can serve only as stimulants of faculties already in existence; otherwise the same facts would give to each individual and each species of animal the same mental character. Boys and girls have a far freer intercourse before puberty than afterwards, yet the impressions on the external senses excite no sexual thoughts: these are excited when the sexual faculty comes into existence, and that is when a certain portion of the brain acquires a certain composition, structure, and size. Neither are impressions on the external senses really necessary to excite dormant passions; they supply merely objects, and augment the force of the faculty: but the faculty may be felt without them. The sexual desire may be felt as a want, without objects.

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[a] Printing, steam vessels and carriages, the magnetic telegraph, and even the penny post, effect what could formerly not have been looked forward to without subjecting the man of philosophic penetration to the imputation of madness.

[b] " In new-born children it is difficult to discover, without previous maceration in spirits of wine, any traces of fibres in the large mass of reddish grey substance in the great cerebral ganglions which strengthen and perfect the hemispheres, or, as others will have it, which put them into a state of activity, — into action. The nervous fibrils are visible in the middle and posterior lobes earlier than in the anterior. In the same way, the fibrous structure of the white substance of the cerebellum is perceptible to the naked eye, only by degrees, and in proportion to its developement. All the nervous fibrils, at this early age, are still so submerged in the more or less red and gelatinous substance, and in the blood-vessels, that the whole brain has the appearance of a pulp, — of jelly.

All the faculties are imperfect at first. One faculty comes into existence after another, and some are faint, and when stronger perhaps still indefinite, long before they are what they are destined

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" The only functions of the infant, at this period, are those of the five senses, of voluntary motion, hunger, the sensation of ease and of pain, and the want of sleep; and even these are very imperfect.

" After some months, those parts of the brain situated towards the anterior superior region of the forehead begin to increase more rapidly than the other parts. The forehead, from its previous flattened form, juts out in front, and the child begins to fix its attention upon external things, to compare them, and to form abstract ideas, — to generalise.

" The whole brain is successively more and more developed, until, at the age of from 20 to 40 years, it has attained its full growth relatively to each individual. The cerebellum too, which, relatively to the cerebrum, is smaller in proportion to the youth of the individual, is developed and becomes perfectly formed towards the age of from 18 to 25 years. The youth, and the young man and girl feel an interest for each other; the talents and propensities are manifested, are exercised and perfected up to the age of maturity." (Gall, l. c. 8vo. t. ii. p. 156. sq.; see also 4to. vol. ii. p. 256.)

to become, for instance, parental[c] and sexual love[d]: just as every proximate principle[e] and every structure, — the result of nutrition, and every secretion, and all other functions than the cerebral, are at first of low degree and imperfect quality. A very large organ in the brain of children is that just above the nose, and termed by Gall the sense of things, —that by which we observe things in general. The whole augments, and each cerebral organ increases and changes in its composition and structure, and in the very same proportion its faculty becomes more forcible and definite.

Experience of course is of the highest importance: but without the internal faculty it would do little. Experience will not give a brute the intellect of a man; neither will it make a genius of a blockhead. The internal faculty is requisite to experience. It, in truth, is what experiences. The improvement and ripeness of the internal faculty is too often mistaken for the result of experience. The faculty ripens as the organ becomes more perfect, judgment becoming true. The slow perfection of structure is seen in the eye and ear. A child is very near-sighted till the fourth month, and hears near sounds only; and till then the cornea is very convex and the lens round, and the meatus auditorius is shallow and the mastoid process very small. Many assert that all external objects are as a coloured mass presented to the infant's eye: that, when some of them move, it is as if certain parts of the mass detached themselves: and that thus the distinction of objects is learnt, and subsequently that by experience distances are appreciated. But, when the eye is perfect, and the corresponding internal faculties also, at birth, objects are known as distinct, and distance is appreciated, at the very moment of birth. If a chicken, just after leaving its shell, sees a motionless fly, it will dart at the insect, and measure the distance between the point of its beak and the insect most accurately; without experience, it knows there is a distinct object, and how far this is from it: and it feels the instinct to take food, and exerts its will and the requisite action of the muscles with unerring nicety.[f] Much knowledge, and much volition, is intuitive; much the result of experience. But much of the result of the perfection of the internal organ, and of its faculty, is erroneously ascribed to experience: for different animals possess different degrees of knowledge of objects, distance, &c., at very different periods of existence and experience; just as they possess different degrees of muscular power at different periods, the lamb and calf standing and walking as soon as they are born, while the child cannot under a twelvemonth, and the chicken possessing at birth the powers just mentioned.[g] A young monkey, as soon

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[c] The little girl loves her doll though she knows it is inanimate.

[d] See p. 1002.

[e] "The strong tenacious glue, employed in the arts, is made from the firmer parts of the hides of young animals: while the gelatinous size, or weak glue, is made from the skins of younger and more delicate animals. These two varieties of glue differ from one another in the weights of the modifying supermolecules of water which enter into their composition. In general, it may be observed, that the substances composing the frame of young and of old animals differ chiefly in the weights of their modifying supermolecules of water; and that the dissimilarity of their properties is chiefly owing to this difference." (Dr. Prout, *Bridgewater Treatise*, p. 488.)

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[f] Sir James Hall was making experiments on hatching by artificial heat. A chicken was in the act of breaking from its confinement when a spider ran along. The chicken instantly darted forward, seized, and swallowed it. Here not only was the eye perfect, but minute muscles, instinct for feeding and judging what was proper for food, for judging of distance, and for putting its limbs in motion and duly apportioning them for given ends. (*Phrenological Essays*, by Sir George Mackenzie, Bart., p. 38.) I laid a dead fly near a chicken scarcely dry from its shell, in the Eccaleobion, with the same result, as soon as it was descried, except that it was not swallowed down.

[g] I must indulge my readers with a quotation from Gall in refutation of the third-rate, unphilosophical, inconsistent, and, in regard to the brain and its functions, the uninformed and the careless, if not dishonorable, Professor Rudolphi. See also Gall's ample exposure of them, l. c. 4to. vol. ii. pp. 393. sqq. 401. sqq. 413. sq. 426. sq.; 8vo. t. vi. p. 119. sqq., t. ii. pp. 441. sq. 458. sqq.; and Dr. Combe's sensible remarks upon Dr. Rudolphi in the *Phrenological Journal*, vol. i., and in his brother's *Translation of Gall on the Cerebellum*, p. 241. sqq.

" *Objection.*—M. Rudolphi thinks that the non-simultaneous developement of the qualities and faculties may be explained otherwise than by the developement of the organs which takes place at the corresponding periods. ' The child,' says he, ' commences by receiving impressions; it is not until after having seen or read much that he can begin to compare and judge: judgment, therefore, will be subsequent to the impressions, for judgment supposes acquired knowledge. It is the same,' says he, ' with all the faculties of the mind: they cannot be developed until the conditions necessary to their existence are fulfilled.'

" *Answer.*—Without doubt, it is necessary to have experienced many sentiments, to have acquired many ideas, in order to draw comparisons and form a judgment. But neither experience, nor any amount whatever of sentiments and ideas, could enable man to compare these sentiments and ideas or to form a judgment upon them. According to M. Rudolphi's view of the case, each intellectual faculty as it can move, calculates distances with precision when it jumps or seizes an object.

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should be the more completely manifested as the materials coming from without are more abundant. The soldier who has been in the greatest number of battles would make the best general; the literary man who has studied rhetoric and the art of poetry with the greatest care, and read orators and poets with the greatest assiduity, would make the greatest orator, and poet. The lower classes would be justified in regarding the attendant who has passed his life in hospitals as an excellent physician. The means would be found of forming great men of all kinds at pleasure.

" But experience belies this supposition. Let thousands of facts be presented to a child; he will seize them perhaps with facility, and retain them without forgetting one; but will he therefore judge of them with the deliberation of a man? Where are the great orators, the sublime poets, formed by the study of the principles of the art? Why do the intellectual faculties deteriorate in old age, although experience and the copiousness of the subjects of comparison are continually augmenting?

" External objects are nothing to animated beings, except in so far as these are rendered capable of receiving impressions from without and of re-acting upon them by external and internal instruments. Let the monkey live for ages in the midst of men, he will always remain a monkey. Give facts to an imbecile, teach him the rules of the arts and sciences, surround him with thousands of models; useless cares! The charms of a very Venus would not move the passions of an unripe boy.

" But, when the senses are perfect at birth, they need neither experience nor exercise for the manifestation of their functions. The spider spins its web as soon as it quits the egg; scarcely has the butterfly spread its wings, when it begins to suck nectar from the flowers, and experiences the sexual desire; just as the robust young man, the moment his organs have acquired their full developement, burns with the desire of finding a companion. It is not, therefore, the accidental influence of external objects which is the first cause of the action of an organ; it is the activity of the organ itself. Now as, according to eternal laws, the different organs do not all acquire their final developement at the same period, the manifestation of their functions ought to commence, diminish, and terminate at different epochs:—epochs and periods from which the plurality of the organs must necessarily be inferred." (l. c. 4to. vol. ii. p. 409. sqq.; 8vo. t. ii. p. 435. sqq.)

I cannot refrain from giving a most interesting illustration of Gall's soundness by quoting the history of a little girl now living in America, destitute from birth of all external influence by eye, ear, or nose. The boy Mitchel, reported by Dugald Stewart in the *Trans. of the Roy. Society of Edinburgh*, vol. vii., and by Dr. Gordon, vol. vi., was destitute of sight and hearing only.

" There is one whose situation is so peculiar, and whose case is so interesting in a philosophical point of view, that we cannot forbear making particular mention of it; we allude to Laura Bridgman, the deaf, dumb, and blind girl.

The knowledge of signs,—of language, hourly increases: not, however, as adults improve in learning a language, by mere prac-

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"The intellectual improvement of this interesting being, and the progress she has made in expressing her ideas is truly gratifying.

"She uses the manual alphabet of the deaf mutes, with great facility and great rapidity; she has increased her vocabulary so as to comprehend the names of all common objects; she uses adjectives expressive of positive qualities, such as hard, soft, sweet, sour, &c.; verbs expressive of action, as give, take, ride, run, &c., in the present, past and future tense; she connects adjectives with nouns to express their qualities; she introduces verbs into sentences and connects them by conjunctions; for instance, a gentleman having given her an apple, she said *man give Laura sweet apple.*

"She can count to high numbers; she can add and subtract small numbers.

"But the most gratifying acquirement which she has made, and the one which has given me the most delight, is the power of *writing a legible hand,* and expressing her thoughts upon paper; she writes with a pencil in a grooved line, and makes her letters clear and distinct.

"She was sadly puzzled at first to know the meaning of the process to which she was subjected; but when the idea dawned upon her mind, that by means of it she could convey intelligence to her mother, her delight was unbounded. She applied herself with great diligence, and in a few months actually wrote a legible letter to her mother, in which she conveyed information of her being well, and of her coming home in ten weeks. It was, indeed, only the skeleton of a letter, but still it expressed in legible characters a vague outline of the ideas which were passing in her mind. She was very impatient to have *the man* carry this letter, for she supposed that the utmost limit of the Post Office Department was to employ a man to run backward and forward between our Institution and the different towns where the pupils live, to fetch and carry letters."

"She has improved very much in personal appearance as well as in intellect; her countenance beams with intelligence; she is always active at study, work, or play; she never repines, and most of the time is gay and frolicksome.

"She is now very expert with her needle, she knits very easily, and can make twine bags and various fancy articles very prettily. She is very docile, has a quick sense of propriety, dresses herself with great neatness, and is always correct in her deportment. In short, it would be difficult to find a child in the possession of all her senses, and the enjoyment of the advantages that wealth and parental love can bestow, who is more contented and cheerful, or to whom existence seems a greater blessing than it does to this bereaved creature, for whom the sun has no light, the air no sound, and the flowers no colour or smell."

"It has been ascertained beyond the possibility of doubt, that she cannot see a ray of light, cannot hear the least sound, and never exercises her sense of smell, if she has any. Thus her mind dwells in darkness and stillness, as profound as that of a closed tomb at midnight. Of beautiful sights, and sweet sounds, and pleasant odours, she has no conception; nevertheless she seems as happy and tice; but because the various ideas signified by language, and to which a child is originally a stranger from the imperfection of its

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playful as a bird or a lamb; and the employment of her intellectual faculties, the acquirement of a new idea, gives her a vivid pleasure, which is plainly marked in her expressive features. She never seems to repine, but has all the buoyancy and gaiety of childhood. She is fond of fun and frolic, and when playing with the rest of the children, her shrill laugh sounds loudest of the group.

"When left alone, she seems very happy if she has her knitting or sewing, and will busy herself for hours; if she has no occupation, she evidently amuses herself by imaginary dialogues, or recalling past impressions; she counts with her fingers, or spells out names of things which she has recently learned, in the manual alphabet of the deaf mutes. In this lonely self-communion she reasons, reflects, and argues: if she spells a word wrong with the fingers of her right hand, she instantly strikes it with her left, as her teacher does, in sign of disapprobation: if right, then she pats herself upon the head and looks pleased. She sometimes purposely spells a word wrong with the left hand, looks roguish for a moment and laughs, and then with the right hand strikes the left, as if to correct it.

"During the year she has attained great dexterity in the use of the Manual Alphabet of the deaf mutes; and she spells out the words and sentences which she knows, so fast and so deftly, that only those accustomed to this language can follow with the eye, the rapid motions of her fingers.

"But wonderful as is the rapidity with which she writes her thoughts upon the air, still more so is the ease and accuracy with which she reads the words thus written by another, grasping their hand in hers, and following every movement of their fingers, as letter by letter conveys their meaning to her mind. It is in this way that she converses with her blind playmates; and nothing can more forcibly show the power of mind in forcing matter to its purpose, than a meeting between them. For, if great talent and skill are necessary for two pantomimes to paint their thoughts and feelings by the movements of the body, and the expression of the countenance, how much greater the difficulty when darkness shrouds them both, and the one can hear no sound!

"When Laura is walking through a passage way, with her hands spread before her, she knows instantly every one she meets, and passes them with a sign of recognition; but if it be a girl of her own age, and especially if one of her favourites, there is instantly a bright smile of recognition — an inter-twining of arms — a grasping of hands — and a swift telegraphing upon the tiny fingers, whose rapid evolutions convey the thoughts and feelings from the outposts of one mind to those of the other. There are questions and answers — exchanges of joy or sorrow — there are kissings and partings — just as between little children with all their senses.

"One such interview is a better refutation of the doctrine, that mind is the result of sensation, than folios of learned argument. If those philosophers who consider man as only the most perfect animal, and attribute his superiority to his brain and experience, become successively possessed by it. At first, not the signification only, but the thing itself signified, was not and could not be known to it. As it knows things more, it rapidly acquires a knowledge of their signs. Children learn languages, when their intellect and feelings are ready with the ideas, as fast as languages can be communicated to them.

The great proportion of the size of the heart gradually lessens: at birth its size is to that of the body as 1 to 120 or 150; in the adult as 1 to 200. The arteries grow more spacious, but the veins continue narrow till about the fifth year; the foramen ovale and canalis arteriosus are quite obliterated about the second dentition. The pulse gradually becomes slower, though stronger:— from being at birth 130 or 140, it is reduced to 120 or 125 at the third month, and to 115 at the end of the ninth month. The respiration also becomes slower but deeper; the blood grows redder, and acquires more fibrin; and calorification becomes more vigorous.

The red colour of the skin subsides greatly at the end of twenty-four hours. The skin remains dry and perspires little for the first few months, so that the deficiency of calorifying power is compensated by more difficult cooling.

The epidermis of birth all comes away during the first few days. The characteristic colour of the variety does not succeed the

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senses, be correct, then a dog or a monkey should have mental power quadruple that of poor Laura Bridgman, who has but one sense.

"We would not be understood to say that this child has the same amount of knowledge that others of her age have; very far from it: she is nine years of age, and yet her knowledge of language is not greater than a common child of three years. There has been no difficulty in communicating knowledge of facts—positive qualities of bodies— numbers, &c.; but the *words expressive of them*, which other children learn by hearing, as they learn to talk, must all be communicated to Laura by a circuitous and tedious method. In all the knowledge which is acquired by the perceptive faculties, she is of course backward; because, previous to her coming here, her perceptive faculties were probably less exercised in one week, than those of common children are in one hour.

"What may be termed her moral nature, however, her sentiments and affections, her sense of propriety, of right, of property, &c., is equally well developed as those of other children." (*Annual Report of the Trustees of the Perkins Institution and Massachusetts Asylum for the Blind.* Boston, 1839, 1840.) I have been unable to procure the report of 1838, in which, I believe, the case is first mentioned.

redness of birth till about a week has elapsed; and the negro is not perfectly black till the sixth or seventh year.

In Europeans the iris is at first blue and the hair light, though both are black from the first in the negro. The colour of the pigmentum grows deeper, the yellow spot of the retina brighter, and the hair darker as the period of the second dentition approaches, but frequently permanent depth of hue is not acquired till after this is passed. The bile becomes more abundant, and the liver much less; the first watery milk purges away the meconium, and if, instead of the mother suckling, a nurse who has furnished milk some time is employed, purgatives are required. The bile is at first weak and small in quantity, so that the fæces and intestinal flatus smell sour, and the stools are of a pale yellow. The latter afterwards become darker, and smell fœtid. The gall bladder, from having been cylindrical, becomes ample and pyriform. The spleen increases, and at the end of the year weighs double; its weight is to that of the body at birth, as 1 to 400; in the adult, as 1 to 200. The kidneys are proportionally as heavy again as in the adult,—being to the weight of the body as 1 to 120; their lobules gradually coalesce, and the right kidney at length becomes placed rather lower than the left. The first urine usually soon follows the first respiration, and is nearly as inodorous and colourless as water, without much urea or phosphate of lime, but impregnated with benzoic acid[h] and does not become yellowish or acquire a urinous smell till the fifth month; grows yellower towards the end of the second year, and begins to contain more urea and phosphoric acid. It and all the secretions, except the saliva which diminishes after the first dentition, gradually grow more abundant and acquire more intensity of character, just as the solids increase and become more perfect.

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[h] A female child was still-born at 8 months with each ureter impervious: the pelvis of the left kidney contained 4 ounces, and of the right 9 ounces, of fluid, of 1012 sp. gr., brown, transparent, inodorous, slightly acid, containing lithic acid and urea, albuminous, affording the phosphate of magnesia and ammonia on the addition of ammonia after the removal of the albumen, and a strong acid, like that of the amniotic or rather allantoid fluid, on the addition of alcohol to the fluid evaporated to dryness by Dr. Prout. Cases of similar accumulations had often occurred before from obstructions in the fœtal urethra; and, as urea and benzoic acid have been found in the human liquor amnii in the advanced periods of pregnancy, justified Berzelius (*Traité de Chimie*, t. vii. p. 566.), and Billard (*Traité des Enfans*, p. 451.) in concluding that the fœtal urine is naturally discharged in utero. Neither Dr. Prout nor Dr. Bostock could discover urea or uric acid in liquor amnii obtained for them at six months by Dr. R. Lee. (*Royal Med. Chir. Trans.* vol. xix.) All the various digestive processes go on a little at the latter end of pregnancy; and Boerhaave mentions chyle being visible in the lacteals before food was taken in a child whose abdomen was torn open during labour. (*Præl. in Instit. Rei Med.* t. v. Pt. ii. p. 350.) That the liquor amnii may find its way into the

It is to be remarked that growth is still not uniform in any respect. This not only proceeds at very various rates in different organs at the same time, but at various rates in the same organ at different times; and in the body at large, at different rates at different times.[i]

During the first week after birth, the body does not grow; and during the first four days was found by Quetelet[k], in seven children, to lose 4½ ounces of its weight. From this time it grows rapidly, and afterwards less; but the progress is irregular. From a length of about 18 or 20 inches, and a weight of about 10 or 12 pounds at birth, it attains 24 or 26 inches, and about 18 ounces, by the end of the ninth month; increasing in weight more than in length. The extremities grow proportionally stronger than the rest of the body, and the lower than the upper.

The average length and weight are thus given by Quetelet in French measures and weights:

Years.	Boys.				Girls.			
	Length.		Weight.		Length.		Weight.	
	Inch.	Lines.	Lbs.	Oz.	Inch.	Lines.	Lbs.	Oz.
2	30	3	24	3½	29	9	22	12½
3	33	0	26	10	32	6	25	3
4	35	6	30	6½	35	0	27	12½
5	37	9	33	11	37	3	30	11
6	39	0	36	13½	39	6	34	3
7	42	0	40	13	41	6	37	8

The incisores teeth of the second set ossify; and, from the

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stomach is proved by the hair of the quadruped fœtus being sometimes found in the meconium. (*Phil. Trans.* 1755. Haller, *Elementa Physiolog.* t. viii.)

[i] See *suprà*, pp. 928. 945. 956.

[k] *Sur l'Homme et le Developpment de ses Facultés.* Paris, 1835.

eighth to the tenth month, the follicles of its first and second molares form, in addition to its already ossified third molar and the follicles of its canine, so that, with the 20 teeth of the first set, at the end of this period the jaws contain 44 dental germs. At the fourth month, the rudiment of the crown of the inner incisors of the second set is seen, in the form of a fine band, with a sharp undulating margin elevated in three points. At the sixth month, the external incisor has the same form, but the internal has grown higher. The third molaris, of which at birth only a small pyramid existed, consists of three detached tubercles in the upper jaw, and of four or five in the lower, disposed in a circle, and having at their bases three narrow tongues which unite them. In the third month, the tubercles form a crown, but still are not entirely united; the follicles of the second set lie between the milk teeth and the posterior wall of the alveolus and rest immediately upon this; their connection contracts to a mere chord, and there is developed, at the bottom of the alveolus between the two sets, a long partition, which allows an opening at its upper part only for the passage of the chord. In the lower jaw, the teeth of the first set have a particular branch of the maxillary artery which penetrates the jaw, below the permanent dental artery, through a special foramen, traverses the bone below the artery, escapes through another foramen, and anastomoses with the artery.

About the ninth month the first set are so grown that, being resisted below by the bony floor of the alveolus, they begin to pierce the gums, and are all *cut* by the end of the second or the middle of the third year. The germs of the second set insinuate themselves below the roots of the first set, and must contribute as they swell to the extrusion of these. The coverings of the first set, having now performed their office and existed their time, naturally perish. The dental follicle, after having secreted the enamel for the crown, becomes fine and dry, and its vessels disappear; it splits opposite the summit of the crown, and is borne away in fragments, except a small portion which invests the root and serves to guide the vessels. The fibrous follicle also opens at the points corresponding to the projections of the crown, and, after they peep forth, it attaches itself loosely to the neck of the tooth, while, like a periosteum, it lines the ossifying walls of the alveolus.

The cartilage, growing thinner and thinner towards the end of the first nine months, disappears when the teeth, instead of which it existed, are cut, since it cannot but perish when the dental vesicle to which it is attached and from which it probably received vessels is opened. This first dentition often is very painful and produces pyrexia and sympathetic irritation of various organs. But the daily ascription to it of every disease which a child may happen to have during dentition, even when it is not severe, is as absurd as the blame attached to intestinal worms daily and when they even do not exist. The lower inner incisors are generally cut the first, and in the ninth month; then the upper; the four external generally appear in the tenth month. The four first molares are cut at the beginning of the second year; the four canine towards the middle; and the four second molares at the end of it. The order of teething is beautiful: for, when a tooth is cut, that which corresponds to it in the other jaw appears, and thus both are at once useful; and the corresponding teeth on the two portions of each jaw follow each other, so as to produce a row. Whatever be the difference in the length of the teeth, the crowns are all of the same height, so that they co-operate perfectly in mastication.

Children are sometimes, though rarely, born with one or more teeth, as was reported of Richard the Third.[1] Sometimes teeth never come: and sometimes the first set, or a number of them, are never shed, and the corresponding ones of the second set do not appear.

In all other mammalia teething is earlier and more rapid: many are born with teeth. But, as labour is agonising to them as well as to the mother descendants of naughty Eve, so teething is painful to their young as well as as to naughty Eve's little descendants. Moses gives no moral reason for this, as he does for women's agony in labour. The pain and irritation appear inevitable in the nature of things. As soon as a tooth is cut, its enamel, which was of a dead white, becomes brighter and more solid; its root still grows; but the crown soon wears down. The pointed summit of the incisors becomes flat and even the enamel is worn away at the fourth year, so that a yellow streak of bone is seen upon the edge of their crown, and a brown spot upon the flattened top of the canine which becomes a semilunar surface.

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[1] "O, Jesus bless us, he is born with teeth!" *Henry VI.* 3d Pt. Act v. sc. 6.

All this time the second set of teeth are growing. The crown and bodies of the incisors are formed; the crown of the canine and first molaris, and the body of the third molaris, form at two years; the crown of the third molaris at the third; the root of the incisors, and third molaris, the crown of the canine and two first molares, in the fourth year, when also the tubercles of the fourth molaris ossify, and the follicle of the fifth appears, so that there are now 52 teeth, — 20 cut, 28 ossifying, and 4 still in formation. At seven years, the incisors and third molaris are perfect; the root of the canine and two first molares begin to form; the crown of the fourth is developed; but ossification has not yet begun in the fifth.[m] In beautiful conformity with dentition, but not in consequence of it, the child in the latter half of the first year begins to like other food than the milk, and is not contented with one kind nor with liquids; and at length cares little for the breast. At the same time the milk becomes less nutritious, sometimes it grows of bad quality: sometimes the catamenia recommence or pregnancy takes place. The mother's milk was very sweet: and sugar is highly grateful during the whole of infancy and childhood, whereas fat, so agreeable to adults, is disliked. As the food now taken requires a long process of assimilation, for which the more vigorous digestive organs are qualified, it remains longer in the stomach and intestines; whence neither hunger nor the desire to defecate is so often felt: the stools become more consistent, of a deeper yellow, and of a fæcal odour.

From the increase of strength, the mortality diminishes; so that,

In the 1st	year	it is as	1	to	4
2d	—	—	1	—	8 or 9
3d	—	—	1	—	10 — 16
4th	—	—	1	—	20
5th	—	—	1	—	30 — 40

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[m] Serres, *Essai sur les Dents.*
Ph. Blandin, *Anatomie du Système Dentaire.*
Rousseau, *Anatomie Comparée du Système Dentaire.*
Prochaska, *Opera minora.* Burdach, t. iv.

In the 6th year it is as 1 to 40 or 50
7th — — 1 — 60 — 70
8th — — 1 — 70—100

Whatever be the average of any of these years in a country, the average of the following year is less: and the greatest diminution is about the seventh or eighth year.[n]

Ossification all this time proceeds, but for details I must refer my reader to Meckel and Beclard. The greater fontanelle disappears at the second year; the serræ of the sutures are seen on the edges of the bones at the third year, and at the fifth year they begin to close into one another. There is still no diploe, and the processes form but gradually.

As the child becomes able to notice more and more, and to comprehend, and to be susceptible of more emotions, power of appreciation and capability of passion thus advancing together, it displays passion more and more from the period of its birth till the general diminution of irritability and the influence of reason and education bring it to control itself. At first it not only cries at every disappointment, but falls into a violent rage, and, from its strength of emotion and the great excitability of the respiratory organs, sobs violently. Adults sob only when they are in extreme distress. At length it cries without sobbing unless under great vexation or grief. The two sexes at the third and fourth year begin to show a difference in this respect as well as in others. The boy at least is less disposed to cry, and also feels that it is unmanly to cry, while the girl still sobs and cries: the boy plays at soldiers and horses and whatever demands activity of his muscles; the girl prefers dressing and nursing a doll and playing at company.

There is so strong a disposition to vermin in the head, and to worms (oxyures and ascarides lumbricoides in this country) in the intestines, that many writers declare their absence to be a morbid condition. The disposition is ascribed to the abundance of albumen in all the secretions and of vital or nutritive energy. This is much lessened about the time of the second dentition, as well as the extreme irritability which gave an intense liability to inflammation of the contents of the head, chest, and abdomen.

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[n] Burdach, § 538.

The skin, not abounding in red vessels so much as the mucous membranes and the substance of the viscera, is not so liable as those to inflammation: nor is acute rheumatism so prevalent in children as adults, probably from the copious covering of fat possessed by the parts most subject to this disease.

With the progress of the mind, the brain increases and becomes matured in composition and structure. Sömmerring[o] and the Wenzels[p] declare that the brain attains its full growth by at least the seventh year. The two brothers, however, conceive that, though the size does not increase, the structure improves. But Burdach opposes them in this, and asserts that the fibrous portion does not augment or improve, supposing that perfection of both size and structure long precedes perfection of function, and performs function at last only through *exercise.*[q] Now, if he were right, we must have the strange fact of a human organ being ready for its function at least twenty years before its perfect size, composition, and structure perform perfect functions; for the mind is not at its full strength till near the thirtieth year. If general perfection of organ only waits for exercise to make it available, how is it that one faculty appears after another, not according to the chance of exercise, but to a regular law? How is it that children seven years of age, sleeping and playing together, for the most part do not show the least sexual feeling, but that all at once in a few years they feel desire, even though each sex is kept in the utmost seclusion, with no example and no exercise. Excitement from without and exercise will arouse dormant faculties; but the faculties must exist, and the organs of the faculties must be more or less advanced. The new being sees, hears, thinks and wills at eight months, if accidentally driven into the world then, and would do none of these things for a month if allowed to remain in the womb till its full time. But let it be born before the cerebral organs are much advanced, and it will do none of these things with all the external means of excitement which act successfully on the brain at a later period of developement. The external causes of excitement and the exercise of the majority of the faculties, as well as of sexual desire, are always sufficiently strong at least in civilised life at all ages; but the character makes itself distinct at every age and in every individual, in all circumstances, and this according to the successive growth of each cerebral organ.[r] When an organ

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[o] *De Corp. Humani Fabricâ,* vol. iv.

[p] *De Penitiori Structura Cerebri.*

[q] l. c. § 541.

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[r] "May I not ask, whence the first men, who were surrounded only by brutes, acquired their faculties, and how they created or invented them? Even now, are not many persons, during their childhood, surrounded more by brutes than men? Why do not these children acquire the instincts and propensities of brutes as well as the faculties of men? If children had not similar dispositions with their parents and instructors, how would they be capable of receiving their instruction and profiting by their example. During their early years, when children are almost entirely in the hands of their mothers, and nurses, and women, the boys are constantly distinguishable from girls; every child even differs from another. In process of time nothing can create a resemblance between the faculties of the man and the woman, nor between those of different individuals. In fine, is any art known by which an instructor can create in children envy, love, attachment, anger, goodness, wickedness, ambition, pride, &c.? Can we create any faculty whatever? So little does this power belong to man, that, even when we are absolutely our own masters, we cannot avoid the changes produced by the course of years in our moral and intellectual faculties. Every thing confirms the truth of what Herder says,—'that education can only take place by imitation, consequently by the passage of the original to the copy. This supposes that the imitator must have the faculty of receiving what is communicated to him, and of transforming it into his nature like the food which nourishes him. But the manner in which he receives it, the means by which he appropriates it to himself, and employs it, can only be determined by the faculties of him who receives it. Whence it follows, that the education of our species is in some sort the production of a double action, viz., that which gives and that which receives it. Thus, when we see that men assume the forms which we wish to give them, it is not to be concluded from this that we have created these forms in them; they have borrowed them from other men endowed with the same dispositions.'

"The influence of education, instruction, example, and surrounding circumstances takes effect principally when the innate dispositions are neither too feeble nor too energetic: every sane man, possessing the organisation essential to his species, has, by virtue of it, a capacity for every thing relative to the dispositions proper to man. It is to this that Nature has confined herself in the greater number of individuals. With this mediocrity of moral and intellectual powers, we are passive, so to speak, relatively to the impression of external objects; the internal faculties are not announced by themselves; they are in a state of indifference; they seize nothing, reject nothing forcibly; and, as nothing moves these individuals towards a marked end, they have not, therefore, any determinate vocation. It is of this great majority of men that it is said with reason, that man is an imitative animal. Precepts, institutions, discussion, the cold exposition of the most interesting truths, have but little power over them. It is example—imiis perfect, its tendency to act and its strength find in external circumstances sufficient cause of excitement and exercise,—

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tation—which draws them on, which gives the solemn air, and often character, to the son of a magistrate; and the fierce countenance to the son of a warrior; which makes the Frenchman, the German, the Italian, the Englishman, the Russian; which makes slaves, freemen, republicans, &c.; but mediocrity will always be their portion. It is for these men, therefore, that education is almost every thing, at least in relation to social life: it is for them that institutions must be calculated. Yet it is not allowable to conclude from this, that their disposition to receive this education is not innate. When Helvetius maintains that, if dispositions were innate in man, education could not change any thing in him nor give him any thing, he abstracts from the nature of man and brutes every possibility of being modified, and confounds simple modifications with essential qualities and faculties.

"It must not, however, be imagined that, even for this class, the impressions which come from without have an exclusive, absolute, and always equal influence. If we succeed in introducing into a nation a certain uniformity as regards customs, opinions, manners, professions, the arts and sciences, the laws, and religion, it is because all these things are founded, not only upon positive relations, but likewise upon natural dispositions. Without denying the influence of institutions, it is always evident that the general progress of civilisation is the result of the organisation proper to mankind.

"In the midst of these positive things which seem to have been introduced by institutions, by arbitrary inventions, every individual differs from another in specific character, just as he differs from him in the external form of his body. Such a quality is given to one, and not to another. Each has a predilection, or a more decided talent, for such or such an object. There is, in every man, therefore, something which he does not derive from education, which even resists all education. Accordingly, all instructors have experienced that particular rules must be observed for each pupil, if they would perfect the good and correct the evil qualities which are peculiar to him, and put him in a condition to employ them in the manner the most useful to society and to himself.

"This individuality, this character peculiar to each individual, shows itself in a thousand ways at every period of life, without education having any part in it. From his infancy, man announces the character which will distinguish him in adult age. When you exalt his merit for some excellent quality, or censure him for some vicious quality, he appears surprised at it himself, as at a thing of which he acquires a knowledge for the first time. You bring him to the point. '*Ah, well!*' he exclaims; '*it is in my nature; I cannot do otherwise; it is stronger than I,*' &c. Let us therefore follow the example of Marcus Aurelius, who held it as a maxim, 'That it is not in our power, nor in that of a sovereign, to create men such as they should be, but that it depends upon us, and upon the prince, to employ them, such as they are, each according to his talent.'

"How can we attribute to education those most decided dispositions and faculmakes opportunities of circumstances which, though rendered a thousand times more favourable, would be lost on an organ a

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ties which are sometimes observed even in children, and which consequently are anterior to every kind of instruction. Most great men have manifested their future greatness in their early years. Achilles, disguised in the clothes of Pyrrha, seized a sword from amongst the presents brought by Ulysses; Themistocles, when still a child, said that, if he were intrusted with the government of a small town, he should know how to aggrandise and render it powerful; Alcibiades, seeing a carter about to derange his game of knuckles, lay down across the middle of the street, crying out to him, '*Come on if you dare;*' Alexander would not contend for the prize in the Olympic games unless his rivals were kings; it was at the age of 14 that Cato of Utica disclosed the greatness of his character and his horror of tyranny; Pascal, at 12 years of age, gave promise of his genius by publishing a treatise on the conic sections.

" Experience proves how little is the power of education, when acting upon very energetic dispositions. Men endowed with an eminent character and great inlectual faculties make their way and elevate themselves in spite of the greatest obstacles: Moses, David, Tamerlane, the Pope Sextus Quintus had been shepherds. Gregory VII. was the son of a carpenter; Socrates, Pythagoras, Theophrastes, Demosthenes, Shakspeare, Molière, J. J. Rousseau, were the sons of artisans. These examples, with which history abounds, refute Hobbes, who maintains that the difference of talents or mental faculties is produced by wealth, power, and the condition in which we are born.

" It is even observed that, in spite of the most decided opposition and of an education the most opposed to the innate character, nature, when endowed with energy, almost always prevails both in the good and the bad. Tacitus justifies Nero's two instructors. This prince was cruel from his infancy, and to all the lessons of humanity given him by his masters he only opposed a heart of brass. Wise and learned philosophers cultivated the heart and mind of Commodus: but nature prevailed over education; in him was seen a second Nero. The energetic character of Peter the Great could not be enervated either by the corrupt principles with which he was surrounded, or by the pleasures by the aid of which it was attempted at a tender age to render him effeminate.

" The greatest men, it is true, bear the stamp of their age, and cannot entirely escape an impression from surrounding objects; yet we constantly see that he who possesses a predominant energetic quality or faculty pursues his particular course, and seizes with force the object which nature has indicated to him. Thomas, in writing the eulogy of Descartes, did well, therefore, in not dwelling much upon his education. 'For,' says he, 'when we have to do with extraordinary men, we must consider education much less than nature. There is an education for common men; the man of genius has the education which he gives himself, and which consists principally in forgetting and effacing that which he has received.' Fontenelle, in pronouncing the eulogy of the Czar, said, 'Neither thousand times less powerful. The truth is that the brain grows for a great many years. If you examine the heads of children

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does a good education make the great character, nor does a bad education destroy it. Heroes of all kinds come out ready formed from the hands of nature, and with qualities insuperable.'

"Great men have almost always been educated by inferior masters, or not at all; Homer, Petrarch, Tasso, Dante, Raphael, Michael Angelo, Racine, Molière, Corneille, Titian, Rubens, Poussin, &c. &c. And great masters rarely form great men. What, then, are we to think of the public, who innocently think they must make the best choice, of a physician for example, merely because he has been educated by a celebrated professor?

"Geniuses of all kinds, say the antagonists of innate dispositions, are exceptions, and form a separate class; we cannot conclude from this, that the qualities and faculties are innate. Genius is only a very energetic activity of some quality or faculty; if, therefore, in cases where the faculties have the greatest energy, the cause which produces it, and which is then the more striking, is inherent in the organisation, we must naturally conclude that the cause of their ordinary activity is equally based upon the organisation. The difference of more or less proves nothing against the common origin of obscure and decided faculties, otherwise we must conclude from the piercing sight of the eagle, and the acute smell of the dog, that the sight of the mole, and the smell of man, do not depend upon their organisation.

"If from any circumstances a man endowed with certain faculties very active has been prevented from following his vocation, the predominant faculty or propensity determines the favourite enjoyments or occupation of his life. Kings devote themselves to the occupations of artists and artisans; husbandmen, shoemakers, weavers, shepherds, become astronomers, poets, philosophers, actors, or sculptors. The Czar Peter I. exercised the mechanical arts from inclination; Louis XVI. performed the labours of a locksmith; the pastor Hahn made watches; Haller in the midst of his anatomical and physiological works became likewise celebrated for poetry.

"If any still maintain that precocious genius or any other genius is the result of education and of surrounding objects, let them tell us why certain children who, with regard to one of their faculties, evince extraordinary genius, do not raise themselves above their companions in any other respect; and why men who excel in one point are so ordinary in every thing else. The celebrated Betty, who at the age of 13 was already considered a very great comedian, would play with other children in the street up to the moment when he had to appear upon the stage. William Crotch, celebrated at six years of age for his musical genius, was in every thing else a child of only moderate intelligence.

"I made the same observation upon a boy of 5 years who manifested complete virility and the most decided propensity for women: he had nothing to distinguish him from children of his age in all his other inclinations. The seven years of age and upwards, you will find the average size much below that of the adult head. Every hatter knows that

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same contrast is remarkable in adults. The most extraordinary faculties prove nothing in favour of qualities of a different kind. Cæsar could never have been made a Horace, nor Alexander a Homer. Helvetius himself is obliged to admit that education would never have changed Newton into a poet, nor Milton into an astronomer: neither would Michael Angelo have been able to compose the pictures of Albano, nor Albano those of Julio Romano. We can explain these different phenomena only by saying that certain organs are perfected earlier and others later; that, in certain individuals, some organs remain always in the back ground, whilst others acquire the greatest energy. But this explanation is a new proof that all the moral qualities and intellectual faculties are innate.

"Some have recourse to little subterfuges in order to prove that our propensities and talents are the result of chance; it is, say they, insignificant impressions upon the infant at the breast, it is particular examples and events, which determine sometimes one faculty, sometimes another. If Demosthenes became eloquent, it is because he was led on by the eloquence of Callistratus. If Vaucanson became celebrated in mechanics, it is because, while an infant, he had seen a clock in the antechamber of his mother's confessor; he examined its wheels, made a similar machine with a bad knife, and, his taste developing itself, he soon constructed an automaton flute-player and the most astonishing machines. Milton would not have written his poem had he not lost his situation as secretary to Cromwell. Shakspeare wrote tragedies only because he was an actor: instead of becoming an actor he would have remained a wool-stapler, like his father, if some errors of youth had not constrained him to quit his native place. Corneille fell in love and wrote verses for the object of his passion; it is to this circumstance that we are indebted for this great dramatic poet. Newton saw an apple fall; what more did he want to discover the laws of gravitation?

"I admit these facts. All that can be concluded from them is, that our propensities and talents are not always put into activity of themselves; that it is often necessary that the impulse be given them by an external impression, or that the material object upon which they should exercise themselves be offered them. The cock does not fight if he has no rival to oppose him in his amours. The beaver does not build if he has no branches of trees, just as no animal generates without a female; without an obstacle, there would be no firmness; without an enemy, no generous pardon. In all times, great events cause the appearance of great men; not that circumstances engender their intellectual qualities, but they furnish an ample career for the liberal exercise of their faculties. Many men, without doubt, only arrive by these means at a knowledge of their own genius; but, if certain qualities sometimes remain inactive at first for want of circumstances, the power and solidity which these faculties afterwards evince show plainly enough that their existence had preceded their action. Is it not evident that, without particular dispositions in the examples opposed to me, the

the sons of most of his customers require hats of larger and larger sizes every year till they are men. Nay, the head grows in some

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objects offered by hazard would not have been seized as they were, nor with the same energy. How many are the children upon whom works of art make little impression, or whom the sight of these works does not render artists!

" Vaucanson bestows the greatest attention upon the arrangement of the clock; he examines it with much care; the first essays which he makes in such works, with bad tools, are successful: now this very attention, and this rapid success, prove that there existed a relation between his faculties and the mechanical arts. Thucydides shed tears of emulation, on hearing Herodotus read his history to the Greeks. It certainly was not that reading which created in him a style concise, compact, lively, forcible, and rich in ideas. It was not the reading of the poem of *Henry IV.* which inspired La Fontaine with his peculiar talent for poetry. How many secretaries lose their situations without becoming Miltons! How many persons are in love and make verses, like Corneille and Racine, and yet these have not yet found a successor!

" If the most frivolous accessory circumstances produce striking differences in the propensities and talents, why does not education, which can create circumstances at pleasure, adopt this new mode of forming great men? And why shall we always have cause to complain that, in spite of so many establishments for education, great men are such rare phenomena?

" I certainly do not deny that good models are of great utility, nor that the study of these models ought to constitute an essential part of education; but, if it be necessary, or sufficient, to have excellent subjects for imitation, whence have Homer, Petrarch, and Dante drawn their divine art? Why are not the talents of Tacitus, Cicero, and Titus Livius reproduced, although so many learned persons know these great men by heart? Why do Raphael, Mozart, Haydn, produce so few disciples? and why is a lapse of several ages always necessary before we can see a few great men shine in the annals of history?

" Another objection is drawn from that uniformity which we find amongst men on a hasty review of all the individuals of a nation; and they would conclude from this that the faculties of man are only a result of social institutions.

" But this uniformity proves precisely the reverse; for we find it in essential things not only in the same nation, but amongst all people, in all times, however different may be the external influences of climate, food, laws, customs, religion, and education. In like manner is it preserved in all the individuals of the same species amongst brutes, under whatever climate and whatever external influence. This uniformity is, consequently, the strongest proof that nothing can derange the plan which Nature has prescribed by means of the organisation. For the rest, the panegyrists of the creative power of education are in contradiction to themselves. At one time the uniformity which they remark amongst men serves for them to prove that education does every thing: at another, in order to explain the difference in characters, they allege the impossibility of the greater number of individuals receiving a uniform education.

to a late period,—till near or past forty. Gall told me that Napoleon's hatter assured him that the head of that ruthless destroyer of human life grew to the age of thirty-five. Phrenologists know that different parts of the head grow differently at different ages, and that the forehead or particular parts of it sometimes grow very much in young adults. Casts have now been taken of the same individuals at various ages in many instances, and the changes of the different parts of the skull and therefore of the cerebral organs are very great; for the hard parts depend much for their size and form upon the soft, and the skull exactly represents the brain when in the healthy state and before decline begins.[s] In some instances it is said that accidental exercise has caused the increase. But generally this has been the result of natural tendency to developement. No amount of exercise will make a giant of a dwarf, make a small eye large, or lengthen a limb or finger: exercise will make an organ plump,—make it thicker and more vigorous: but it is limited in its power by the limits of the natural laws of the individual. Deficiency of good food and of the stimulants heat, light, &c., and the influence of noxious agents, may stint the natural growth of an individual,

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" After all, let us consult those persons who consecrate their whole life to the education of man, such as Campé, Niemeyer, Pestalozzi, Salzmann, Gediké, May, Eschké, Pfingsten, the Abbé Sicard, &c. Every day furnishes them occasion to remark that the dispositions in each individual differ from birth, and that education can only take effect in proportion to the innate qualities. If it were otherwise, how could these benevolent men forgive themselves, and how be forgiven, for not rooting out from their pupils, all faults, all vices, all fatal passions, and base inclinations! How could satirical authors, moralists, an preachers obtain so little success against absurdities and crimes? Why have not the great and the rich yet purchased the art of giving a great capacity to their children? Believe then that such an art is not entirely in the power of men. It is Nature herself who, by means of the immutable laws of the organisation, has reserved to herself, not the sole, but the first right over all exercise of the faculties and propensities of man and of brutes." (Gall, l.c. 8vo. t. i. p. 133. sqq.; see also 4to. vol. ii. p. 40. sqq.)

[s] " If we examine the cranium comparatively with the brain, in all vertebrate animals, and especially in man, as to national differences, as well as those equally certain though more delicate differences of age, sex, and individuality, we shall be easily convinced that the cranium represents the encephalon in general." *Dictionnaire des Sc. Méd.* t. vii. p. 301. See also further remarks and Gall's reply in his *Fonctions du Cerveau,* 4to. vol. iii. p. 19. sqq.; 8vo. t. iii. p. 34. sqq.)

but the most favourable circumstance will not augment his growth beyond its natural bounds in him. In excess, — carried to the point of inflammatory irritation, or aided by an inflammatory irritation, exercise or irritation of any kind may indeed occasion a diseased growth, — an hypertrophy, at the expense of the healthy performance of the function of the organ and of general health. No exercise will make a Sir Godfrey Kneller or a Sir Peter Lely, into a Rubens or a Vandyke.

> ——— " Sudet multum, frustraque laboret
> Ausus idem."

The same amount of industry at Oxford or Cambridge produces very different proficiency in individuals. Moreover, those brothers and sisters who resemble each other in character present, though brought up apart and under different circumstances, similar successive growths of the different parts of their heads: while those who are incessantly together, quite in the same circumstances, and differ in character, have totally different proportions of successive developement of the different parts of their head. A physician, who was not a phrenologist, the late Dr. John Sims, bestowed great labour in weighing brains, and his results are very different from those of his predecessors. After weighing 237 brains, from the age of 1 year to above 70, he ascertained "that the average weight of the brain goes on increasing from 1 year old to 20: between 20 and 30, there is a slight increase in the average; afterwards it increases and arrives at the maximum between 40 and 50; after 50, to old age, the brain gradually decreases in weight."[t] This, like all accurate observations on points investigated by Gall, confirms the statements made by Gall years ago.[u]

Objectors to the high estimate by phrenologists of the importance of size should reflect that the growth of all parts from the embryo to the perfect man shows the importance of size. Nature does nothing in vain, and she would not cause the nutritive power to augment the bulk of every organ if it did not thereby acquire more functional power.

For minute measurements of different divisions of the brain, cranium, and face, I must refer to Burdach. The nose acquires more of its proper shape and its cartilages lengthen. The heart and liver grow less rapidly, so that proportionally they become smaller. The right ventricle acquires more capacity and grows thinner. The lungs increase; the larynx and trachea continue small, so that the voice is still shrill. The stomach and small intestines lengthen, and the large intestines grow broader. The urinary bladder becomes rounder as well as more capacious, so that the urine is made less frequently and more copiously at a time. As the bones, muscles, and tendons become firmer and change in shape, the child, from sucking more and more strongly and adroitly, begins to masticate; from tossing about, it is able to shuffle from place to place as it lies; then sits also; and, about the end of the first year, it stands; then it gradually walks, first with assistance and for a very short time, afterwards alone and longer, till at length it is independent and runs well; and, from its impetuosity, the greater force of the flexors than of the extensors, and the necessity it finds to make a great effort, like those labouring under paralysis agitans or chorea, it runs rather than walks; but it runs a few steps only, precipitating itself as it were on the object it wishes to reach, and often tumbles forwards. Its brain developing gradually at the same time, it begins, from uttering inarticulate sounds on experiencing feelings and sensations, to articulate, and at length talks as it hears those around it talk, though long imperfectly and disposed to coin words of its own. Its words are substantives — the names of sensible objects: and next verbs. It imitates sounds at first for the sake of imitating without a view to meaning.[x]

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[t] *Royal Med. Chir. Trans.* vol. xix. p. 358. 1835.

[u] l.c. 4to. vol.ii. pp. 256. sq. 407. sq.; 8vo. t. ii. pp. 156. sqq. 430. sqq.

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[x] The child does not at first use the words I, me, my, or mine, and does not hear itself called I or me, or its things my or mine. It is always addressed by its name, as "Tommy come here—Tommy must not do that—that is Tommy's spoon." We feel that, to make ourselves intelligible, we must so speak. It does not know it is I or me; and consequently what belongs to it, it naturally calls Tommy's, not my, or mine. It calls people by their names, and does not say you and your: and we do not speak to it of ourselves and our things as us and ours, at least without explaining ourselves by adding individual names. The mother says mama and mama's book; for example, Tommy must not touch mama or mama's book,—not, must not touch yours; and so on. It is incapable of the abstract notion of self, and the general meaning of personal pronouns. As its faculties grow, it seems to comprehend the meaning of pronouns and soon

It often pronounces words without attaching meaning to them, but from the pleasure of speaking, just as it uses the muscles of its trunk and extremities. The facility with which children learn languages is most astonishing. They appreciate the meaning of any word in the most exquisite manner if they once possess the corresponding feeling or idea. A child will learn two, three, or even four languages orally at once with ease. Of course, its pronunciation is at first imperfect; and not only from want of practice, but from imperfect developement of the organs. For some adults with sufficient knowledge and practice still pronounce certain words like children, and cannot pronounce them otherwise: and several members of the same family may have the same peculiarity.

These circumstances accord with such a change in the digestive organs that a new kind of food can be assimilated; and with such advances in the brain that speech and locomotion are now important; and all these changes, as well indeed as all others which occur, harmonise together completely to the various great ends for which they serve.

Children and young brutes are more joyous than the adult. Not only have they no care for the future, but all trifles give them pleasure: they are angry and miserable for trifles, but they presently grow happy again. They love fun, and rejoice in exercising all their muscles. They frisk and halloo till they are tired; — to the annoyance of their elders, who forget that this is their nature and the effect and cause of health. All children should have ample space for exercise and noise. Existence, all their

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employs them. I have heard it asserted that as children we generalise most, and individualise as adults. This would be doing, when our faculties are the weakest, what requires them in the greatest strength. A child does not generalise, but is insensible of differences. It mistakes two similar objects for the same. After seeing a chicken and learning its name, a child will think a parrot is a chicken and call it a chicken. Just as in after life, when we see numerous similar objects, as a flock of sheep, we cannot distinguish the individuals till after long observation of the flock. As its faculties grow and its experience augments, it discerns the difference, and forms the general notion and indicates it by the word bird. To confound is not to generalise. In generalising we are aware of all the differences of individual things, we confound nothing, but, on the contrary, discover what points of agreement there are among individual things which we have considered as different from each other; and we group them according to their agreement.

faculties and powers, and all the world around them, are new and fill them with delight; and a child has said, in his transport of freshness and happiness, "Mama! what a funny thing it is to be alive."

As the powers of the brain augment, a larger view is taken, objects are seen in connection and in larger and larger number, properties, phenomena, and events: and, since memory grows stronger, and deductions are made, perceptions and all knowledge make a more and more permanent impression. All emotions, like sensations, are at first readily excited and rapidly pass away: but they become gradually less easy of excitement and more durable. Self-control daily increases. Attitudes and gestures in infancy meant little: but, as the mind advanced in ideas and feelings, these of course have all along become more and more expressive.

The first set of teeth were not of hardness to last long or of size to bear the increasing force of mastication, and they cannot grow or become of more perfect structure. The increased length also of the jaw separates them from each other. Their vessels and nerves shrink away about the 7th year; and, when at length the vessels can convey no more blood, the teeth necessarily drop out. As the alveoli grow larger, the roots become less firmly fixed, and their separation is favoured by the pressure of the second set, which gradually causes the partition of the alveoli between the teeth of the two sets to be absorbed, so that both teeth lie at last in one alveolus, as they did originally. The new internal incisor lies below the old: the new external incisor partly under the old external incisor, partly under the old canine, from want of room: and the new canine behind the old external incisor and old first molar: the new molars lie between the bifid fangs of the old molars: the fibrous follicle of the new tooth sprung like a bud from the surface of the follicle of the old tooth, and now, by means of a prolongation like a chord, holds to the periosteum of the alveolus into which the follicle of the old tooth is converted. The crown of the new tooth transforms the chord into a canal, through which the tooth, whose root is now forming, penetrates into the alveolus destined to receive it and containing the first tooth. If the old tooth is not ready to move, the new tooth makes its way through the jaw, its follicles first cracking like that of a tooth of the first set when being cut, and thus becoming the periosteum of a new and special alveolus. The third molaris, which is the largest and strongest of all, is cut at about 7 or 8 years, and announces the commencement of the second dentition. The old set then fall out, and the new appear. First the internal, and then the external incisors change at 8 or 9 years : the first and second molar at 10: the canine at 11. At about 12 the second dentition is completed by the appearance of another molar tooth,—the fourth : and there are now 28 teeth. The roots of the new set are not of full growth for 2 or 3 years, and during this time their alveoli are strengthened by deposits of bony matter within. — The new teeth soon begin to wear, and, about the 12th year, the points of the incisors have disappeared and the crown presents a straight andcutting edge.[y]

3. Boyhood and Girlhood extend from the second teething to puberty. In the previous age, the general difference between the sexes had become more and more striking. In the embryo we have seen that general sexual differences are discernible sufficient to indicate the sex ; and at birth that boys are larger than girls. Sömmerring remarks that in male embryos the chest is larger, more conical, and more prominent anteriorly than the abdomen and pelvis, and supplied with thicker ribs: in the female shorter, broader above, narrower from the 5th rib, more like a cask than a cone, whereas the abdomen is longer and more projecting than the chest. In the male, the head is bigger and more angular, the occiput larger, the vertex less high, the upper extremities stronger, the upper arms more conical, the fore-arms more conical, the wrists broader, the fingers less slender, the pelvis narrower, the nates smaller, the thighs less bulky, the ankles and heels more projecting, the great toes more distinct from the others. Tiedemann says that the male brain is the heavier even at birth.[z] The spinous processes of the lower dorsal and upper lumbar vertebræ form a projection in males, and a depression in females.[a] The difference becomes more obvious daily. The boy's jaws and limbs, especially his hands and feet, grow faster: and, while he loves muscular activity, she prefers playing with her doll. He is bolder and more independent: she gentle and affectionate. She loves small and weak animals: he the large and

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[y] Burdach, § 551.

[z] *Phil. Trans.* 1836, p. 502.

[a] *Icones Embryonum*, p. 4.

strong. He destroys and disorders: she preserves and keeps all in order, is better behaved, and more vain and cunning. Girls catch the meaning and character of superficial matters better than boys and inquire less deeply, being inclined to implicit confidence in what they read and hear. Boys are not contented till they have grasped the whole of a thing and ascertained the reason of all belonging to it, and asked your grounds for what you assert. Girls are thus quicker, and boys sounder. In Germany more girls die now than boys. But the mortality of both is lower at this than at any other period of life,—not being above 1 in 100. The minimum is obtained a year or two before puberty.[b] Girls advance with more rapidity. Girlhood lasts but to 14 years in this country: boyhood to 16.

Growth takes place less rapidly and uniformly. But weight increases more rapidly. The following details are from Quetelet:

Years.	Boys.				Girls.			
	Length.		Weight.		Length.		Weight.	
	Inch.	Lines.	Lbs.	Oz.	Inch.	Lines.	Lbs.	Oz.
8	44	6	44	5½	43	6	40	10½
9	46	6	48	6½	45	6	45	9½
10	48	9	52	6½	47	9	50	4
11	50	9	57	14½	49	6	54	14
12	52	9	63	11½	51	9	63	11½
13	55	0	73	7	53	6	70	6
14	57	0	82	13	55	6	78	9½
15	59	0	93	6½	57	3	86	7
16	60	9	106	2½	58	6	93	4½

The pulse at the end of this age is from 80 to 85. The subcutaneous fat diminishes. The pelvis of girls, and the thorax of boys, increase more rapidly. The thigh in both sexes increases so much more than previously that, whereas before it was shorter than the leg, it is now as long. The thymus usually disappears altogether about the 13th year. The head now grows for the first time more in breadth than in length; the serræ of the sutures of its bones become longer.

4. Adolescence or Youth extends from the commencement of

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[b] Burdach, § 452.

puberty to the termination of growth, — from the 14th to the 20th year in females, and from the 16th to the 24th in males.

The general and local sexual bodily characteristics and the local sexual growth both in the sexual organs and cerebellum are complete. The female menstruates, the male discharges semen: the sexual desire is in full force, and the copulative function capable of full performance. Some time before desire is felt, the girl grows more reserved towards boys; and boys, though they quiz girls for their gentleness, exhibit traces of a chivalrous respect for them. At a later period, before puberty is manifest, obscure desires are felt, not recognised till a still later period to be sexual.[c]

In the female the countenance changes somewhat, and the voice grows stronger from the increase in all the air passages. In the male a great change is observable in the countenance to a degree of manliness, and the voice alters considerably. For a time it is cracked, becoming shrill and hoarse in its tone, and then settles into a grave character, with increased strength and compass. These vocal changes arise from changes in the larynx, just as those of the mind arise from changes in the brain. The larynx had previously grown but little; now it all at once grows with rapidity: the thyreoid cartilage projects, and the glottis is as broad again as before. Richerand found it $5\frac{1}{2}$ lines in length in a boy of 14, and in a year both its length and breadth doubled: while in a girl its length does not exceed 7 lines. The blood acquires an odour stronger than in women and children ; the blood and the flesh have a peculiar odour not observable in old men or eunuchs.[d] Down begins upon the pubes of both sexes ; and after a year[e] above the upper lip of the male, then upon the chin, and at last along the sides of the face. The down gradually becomes strong hair, and thus, in general, moustache, beard, and whiskers ornament the male face. But in some whiskers never appear, or but thinly; and in some the beard also is very scanty. The external and internal genitals all at once grow rapidly; and the skin of the penis and labia becomes dark. The breasts of the female now suddenly swell forth, and ornament her as much as the new hair does the face of the male. The eyes of both now sparkle, and the whole aspect changes to an adult character. Both sexes acquire the axillary and genital odour, as well, I dare say, as others not discernible to us, but some to savages, and some to the brute creation, one to one species and another to another. The girl is surprised by the appearance of menstrual fluid, and the boy by seminal emission: though neither fluid has at first its mature intensity of sensible qualities. The odour of the genitals is useless in civilised man: but in brutes it gives information of the sex, and of the presence of heat, being stronger during desire, especially in the female, and stimulates the opposite sex to gratify the individual which, being ready, affords it. The penis is continually erect.[f] In early youth, however strong the desire and able the organs for the mechanical deed, the organs are still mostly unable to generate. Young girls are occasionally with child, and boys occasionally become fathers; but the acts of the boy or girl who marries are more frequently for a year or two without result: and the same is observed among brutes. I may remark that, whatever be the cause, married people more frequently do not manage matters so as to be fruitful till they have practised together for two or three months.

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[c] See Alfieri's account of his unconscious and innocent love of the Fraticelli Novizi of the church del Carmine, about twice his own age, when he was scarcely seven years old,—an unusually early age for glimmerings of the feeling. Questo mio innocente amore per que' Novizi, giunse tant' oltre, che io sempre pensava ad essi ed alle loro diverse funzioni." "E questo in somma, sotto tanti e sì diversi aspetti, era amore, come poi pienamente connobbi e me ne accertai parecchi anni dopo, riflettando su; perchè di quanto io allora sentissi o facessi nulla affatto sapeva, ed obbediva al puro istinto animale." (*Vita di Vittorio Alfieri da Asta, scritta da Esso*, cap. iii.) I saw a case of precocious puberty in a boy about three years of age, at Dulwich, who endeavoured to lay hold of the genitals of every body, male and female; his desires not being yet fully shapen. That the sexual desire begins in this germ-like way, and sometimes at a very early age, others testify. (See Dr. Vimont, l. c. t. i. p. 236.) "J'ai été deja consulté plusieurs fois par les parents de jeunes enfants des deux sexes de cinq à sept ans, ayant l'habitude de masturbation; et je suis convaincu que le nombre de ceux qui s'y livrent serait reconnu pour être très considérable, si les enfans n'employoient la plus grande addresse pour cacher cette funeste habitude." The frequency of this precocity is the only point that can be questioned. Mr. White, of the Westminster Hospital, details a male case of premature puberty, in which the child masturbated when but two years old and not likely to have learnt the practice from others. (*Med. Chir. Trans.* vol. i. p. 284.)

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[d] Nature's treatment of man is hard. He feels strong sexual desire and can copulate continually. Yet the burning youth can seldom marry, for he seldom has the means of supporting a wife and family ; and, if he indulges nature's strong impulses, stronger in youth than in after life when means may be ample, without marriage, he must probably either ruin the innocent or contract disease: and moreover injures himself by the act ; for early copulation arrests the growth, induces phthisis, and predisposes to endless diseases and premature death. If bulls, rams, or stallions, are allowed to copulate when they first would, they also suffer, ceasing to grow, becoming impotent, or remaining feeble for life. Even young trees are in danger of dying if they bear fruit too early.

[e] I attended a remarkably muscular and hairy gentleman who said he had a strong beard before any hair appeared upon his pubes.

[f] Burdach, l. c. § 562.

Every part in every person does not equally experience the changes of puberty. For instance, the greatest growth of the testes and of the occiput is often accompanied by little beard, or a small larynx, or small calves; a small growth of them with a great beard, or great calves. A boy only six years of age, without any premature growth of the organs of generation, is recorded to have had a beard.[g] Nay, one of the set of sexual organs may be small and another large in the same person. For the growth and also the decline of every part of the system, however connected with others, is more or less independent from the first days of existence to the last. On account of this, instances continually occur in both sexes of early puberty, sometimes joined with very rapid growth of stature. The intellect however does not usually keep pace with the body, (or rather the parts of the brain destined for intellect with the rest of the brain and body,) nor are such individuals commonly long lived. Some males are reported to have been adult before the completion of their first year, an instance of which I will presently give. One of the earliest examples of female puberty is related in our *Medico-Chirurgical Transactions*[h]; the girl began to menstruate when not three years of age, and soon after acquired large breasts, broad hips, &c. Schurig quotes numerous, and for the most part probably fabulous, instances of fecundity in either sex between the seventh and twelfth year, and one of a little couple, who, he being nine and she eight, managed to beget a child.[i] Blumenbach has published an account of a Swiss girl who procreated at nine years of age.[k]

The activity of the grand organs of generation, — the testes in the male and the ovaria in the female, is so connected with the great changes which occur in the rest of the generative organs and in the system at large at the period of puberty, that these changes are prevented if those organs are previously removed[l], and are in general proportional to their evolution and activity; and, when the testes or ovaria have experienced none of the changes of puberty, even some of the marks of the other sex, as large breasts in the male, may occur; and, if their removal is practised after puberty is established, the system more or less relapses into its former condition or acquires more or less the characteristics of the opposite sex. This is well known in regard to brutes and the males of our species. Burckhardt, one of the latest travellers in Egypt, says that the face of those unfortunate creatures who are emasculated when boys appears "almost destitute of flesh, the eyes hollow, the cheek-bones prominent, and the whole physiognomy has a skeleton-like appearance:" the operation is usually performed, between the eighth and twelfth year.[m] Windhus, however, in his journey to Mesquinez met a troop of eunuchs belonging to the king, and declares they were the fattest persons he ever saw. They are said to grow faster than others, but their muscles are poor. We have one instance of the castration of a woman. Her ovaria protruded at the groins, and were so trouble-

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[g] *Phil. Trans.*

[h] Vol. iv.

[i] *Spermatol.* p. 185. sq.

[k] Communicated to him by G. E. ab Haller; see *Bibl. Med.* vol. i. p. 558.

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[l] Such eunuchs have no beard, nor pudendal hair, but a squeaking voice, narrow shoulders, large hips, &c. Dupuytren found the larynx in such a person one third smaller than usual, the rima glottidis narrow, and the cartilages but little developed.*

[m] The original absence, however, of sex, appears in some respects advantageous; for sexless insects are more active and have stronger instincts, and mules surpass the horse and ass in the acuteness of their senses and the certainty of their instinct. (Humboldt, *Reise in die Æquinoctialgegenden*, t. iii. p. 274.)

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* Eunuchs were made abroad to a very late period for the sake of procuring fine singers. We have all heard Velluti. In Naples, formerly, were barbers' shops with this notice; Boys gelded cheap here — *Qui si castrano ragazzi a buon mercato.* A fancy prevailed that if castration was performed in bad weather the voice was not improved by it: and accordingly Paesiello in a rage one day, when a chorus of eunuchs were singing badly, exclaimed, *Maledetti da Dio, foste voi tutti castrati in cattivo tempo.* King Ferdinand cried out, Bravo! bravo! Paesiello, and all the assemblage of ladies and gentlemen clapped loudly.

The operation has no good influence on the brain; for no eunuch, I believe, has proved a great composer by the operation.

some as to induce her to submit to their removal in St. Bartholomew's Hospital; she afterwards grew thinner and more muscular, her breasts shrunk away, and she ceased to menstruate.[n] When the ovaria have been found deficient, the signs of puberty had not appeared.[o] The absence of the uterus only is not necessarily attended by any deficiency in the general changes [p], nor does its removal destroy desire or give a woman the characters of the male. Nay, where it only is absent there may be monthly pains, and most severe ones, in the pelvis, with all the attendant circumstances of menstruation, as if the discharge were taking place.[q]

Sexual desire, like every other, being a mental circumstance, must exist in the brain. The sexual organs are usually regarded as its cause. That this is not the case may be shown by many considerations. Desire is by no means commensurate with the size of the genitals: even when the genitals are precociously developed desire is sometimes not felt.[r] Desire is often felt after the removal of the testes, and in old age when the genitals are powerless.[s] It must, therefore, depend upon some other part. This part appears to be the cerebellum. Desire is, *cæteris paribus*, naturally strong or weak in the adult, not with any relation to the size or strength of the body at large, of the genital organs, or of the cerebrum, but in proportion to the large or small size of the cerebellum[t], whether of the lobes or the fundamental portion called the vermiform process, which alone exists in birds, amphibia, fish, and insects[u]; whenever I have accurately known the natural strength of the sexual propensities in either sex, the size of the occiput has without a single exception corresponded. Before puberty the cerebellum is small; its proportion in size to the cerebrum is at birth from one ninth to one twentieth, or even less: in the adult it is as one fifth, or at the least as one seventh, and acquires its full developement between the eighteenth and twenty-sixth years; and the breadth and prominence of the occiput are proportional. Mr. Combe gives the same result of his examination of above 150 persons.[x] Gall says that in adults the breadth of the cerebellum is from 4 to 5 inches; its thickness from 20 to 25 lines; and its length from 2 to 3 inches and some lines.

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[n] Pott, *Works*, vol. iii. p. 330. A castrator of sows and other brutes in Germany is said to have been so enraged with his daughter for giving loose reins to her passions, as to have resolved to extinguish them, and to have completely succeeded by removing her ovaria.— "Ita bilis mota est, ut, aperto latere, castraret puellam, quam ab eo tempore nulla tetigit veneris cupido." (Boerhaave, *Prælect Acad.* t. vi. p. 127.)

[o] *Phil. Trans.* vol. xcv.

[p] *Mémoires de la Société Médicale d'Emulation.* Paris, tom. ii.

[q] See a case read before the Medicinisch-Chirurgische Gesellschaft, and to be found in the *Lond. Med. and Physic. Journal*, 1819, p. 512. sq. where another is quoted from Theden. I believe I know a living case of this kind myself, but dissection only could clear up the matter. A young woman with every mark of puberty was brought to me by her mother on account of never having menstruated, though experiencing severe monthly pains: remedies proved useless, and she ceased to come to my house. At the end of a year, she returned in the same state but married, and I gave it as my opinion that there was probably some malformation, and requested a manual examination. I found no vagina. My colleague, Mr. Cline Jun., at my request, made an incision between the labia, below the urethra, but found no cavity. Her distress was great, and I requested him, on another day, to introduce a sharp instrument as far as he dared. Still no vagina could be found; nor, when the finger was pushed as far as possible into the wound, could any thing like an uterus be felt. Coitus, such as it was, gave her pain; but her husband was contented, and lived with her till he died of phthisis. She soon married again, for her desires were evidently strong, her occiput and breasts large, and her constitution vigorous. Whether her second husband was as easily contented with his joys as her first, I cannot say: for I lost sight of her. Quite a similar case will be found in the *American Journal of Med. Sc.* May, 1840, where are references by Dr. Chew to others.

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[r] A female infant who cut four teeth at the end of the first fortnight, walked and had hair reaching to the middle of her back soon after the seventh month, menstruated and had stiff brown hair on the pubes and every corporeal mark of puberty at the ninth month, died in her twelfth year, without having shown the least sexual instinct. (*Gemeinsame Zeitschrift für Geburtskunde.*) Gall saw a similar case, and others may be found in Buffon (Gall, l. c. 4to. vol. iii. p. 95.; 8vo. t. iii. p. 260.) Gall found the cerebellum had not grown proportionally,—"had but a very insignificant developement."

[s] Just as desire was ascribed to the testes and ovaria, it has been fancied that the strong and disagreeable flavour of the flesh (and indeed many other of their qualities) of entire animals depends upon the absorption of semen. But Haller remarks that the flavour is as disagreeable in castrated animals, if the operation has been performed late. (*El. Phys.* t. vii. p. 546.)

[t] See Gall's endless facts, l. c. 8vo. t. iii. See also 4to. vol. iii.

[u] Gall, l. c. 4to. vol. iii. p. 91.; 8vo. t. iii. p. 254.

[x] *On the Functions of the Cerebellum, by Drs. Gall, Vimont, and Broussais, translated from the French by George Combe: also, Answers to the Objections urged against Phrenology by Drs. Roget, Rudolphi, Prichard, and Tiedemann*, by G. Combe and A. Combe, p. 171. Edinb. 1838.—

"With the exception of some extraordinary cases," writes Gall, "we have never observed the same proportion between the cerebellum and the cerebrum in subjects under sixteen or twenty years of age as in adults. It is easy to establish the truth of this remark by comparing the skulls of young boys and young girls with those of men and women. What a difference already between the skull of a boy of ten or twelve years of age (Plate 37.) and that of a new-born infant (Plate 41.)! In the new-born infant the whole base of the cranium is still contracted into a truncated cone; the mastoid processes are still near each other; the occipital protuberances are not yet prominent, they are actually flat. In the second year, the mastoid processes are more widely separated from each other; the occipital fossæ have become deeper, and resemble more the segment of a sphere. All these changes are still more observable in the skull of the boy ten or twelve years of age. The imperfect developement of the cerebellum is seen also in the cranium of the young girl of six years (Plate 38.). In turning the base of the cranium of a subject below puberty towards us, we see at once that the distance from the one mastoid process to the other (which distance shows the diameter of the cerebellum) is much less than from the one parietal bone to the other. In the adult, on the contrary, these two distances are in general very nearly the same. Accordingly these facts have at last led M. Chaussier to admit that the cerebellum does not develope itself till towards the age of adolescence."[y]

In old age, the cerebellum shrinks, and, the internal table of the occipital bone following, bony matter is deposited between the two tables, and the bone at the fossæ occipitales becomes much less transparent. Gall possessed old crania in which the cerebellum had returned to the dimensions of infancy, and the occipital fossæ had become shallow. When the cerebellum is precociously developed, desire is felt by the child, even though the genitals are not above the ordinary size.[z] Inflammation and irritation of the cerebellum are found by a multitude of dissections to have existed when great excitement of the genitals occurred before death, and organic disease and injuries of the cerebellum have as frequently occasioned impotence.[a] Whereas parental love is generally stronger in the females, desire is ordinarily stronger in the males of all species; and, in general, as the posterior extremities of the posterior lobes of the cerebellum are usually larger in females, so the cerebellum of the male is larger than that of the female,—the distance between the mastoid processes is wider, the back of the neck and head fuller, indeed the whole is much thicker, and, if the brains of the two sexes are placed in water, the larger cerebellum of the male is very conspicuous. Bulls, stallions, and rams may be distinguished from the female and castrated male by their thick necks.

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[y] l. c. 4to. vol. iii. p. 93. sq.; 8vo. t. iii. p. 257. sq.

[z] "At Paris," says Gall, (l. c. 4to. vol. iii. p. 95. sq.; 8vo. t. iii. p. 261.) "I saw the son of a mulatto, not quite three years of age; he threw himself not only upon little girls, but upon women, and urged them boldly and perseveringly to gratify his desires. The sexual organs were not prematurely developed, but merely of the dimensions usual at his age; yet he had more than momentary erections, as he was surrounded by girls willing to indulge him from the piquant singularity of the

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thing. He died of consumption before attaining his fourteenth year. His cerebellum was extraordinarily developed; the rest of his head of the common dimensions. In every other respect, indeed, he was only an ill-educated spoiled child."

Again, "In two boys, the one three, the other five years of age, both of whom were fully capable of the sexual functions, I found the cerebellum,—the organ of physical love, completely developed, while the rest of the brain was of the size usual at their age. (l. c. 4to. vol. ii. p. 409.; 8vo. t. ii. p. 434.) In a case of puberty at Paris, related by Dr. Breschet, in a boy three years of age, the judgment, as usual, was not at all superior to that of other children, but the part of the head stated by Gall to be the residence of the organ of sexual love was so large that Dr. Spurzheim thought few adults have it of equal size. (*Med. Chirurg. Trans.* vol. xi.) I saw another such boy at St. Thomas's Hospital, also 3 years of age, named John Sparrow, and had a cast of his head taken which may be purchased at Mr. Deville's in the Strand. An account of him is given in the *Med. Chirurg. Trans.* vol. xii., by Mr. South, who speaks with truth of the "enormous size of the cerebellum." (p. 80.) The occiput of a boy whom I saw at Dulwich (*suprà*, p. 1003.) was of the full adult dimensions. Mr. White says nothing of the occiput of the boy whom he describes (*suprà*, p. 1003.), but informs us that the circumference of his neck was 12½ inches and of his head 20 inches.

[a] Diabetes is almost always attended by the destruction of sexual desire and power, and even in an early stage. I examined the encephalon of a young man who had been my patient in University College Hospital under these circumstances, and the cerebellum was to the cerebrum but as 1 to 11 in weight. In a clinical lecture delivered in that hospital, I showed the cerebellum of a boy, containing tubercles, in whom Mr. Bainbridge of Tooting informed me that erections took place continually before death. (See *Lancet*, May 20. 1827.)

The sympathy of the cerebellum with the genitals is the reason of the latter being regarded as the seat of desire. If they are removed, desire is generally extinguished; for the cerebellum is not afterwards developed at puberty, and the back of the head and neck remains small, perhaps smaller than in the female. If one testicle only is removed, Gall invariably observed, in experiments on rabbits, that the opposite half of the cerebellum[b] shrinks, or its substance is in some way altered; and he made the same remark in cases of the removal or injury of one testis in the human subject, or of disease of one ovarium. Gall's experiments have been repeated with the same results by Dr. Vimont.[c] I saw a man who fell in Spain upon his back against a bank, striking his neck and loins, and was stunned. Soon after the testes became painful and then shrunk, and his breasts grew to the full size of those of a woman. He lost all sexual desire and power. The case was seen at hospitals and medical societies. But, from the want of phrenological knowledge, no one there observed an additional remarkable circumstance, which was the extraordinarily small size of his occiput both in breadth and projection. On my questioning the man about it, he declared his complete certainty that it had shrunk since the accident, because his hat, put on as rustics wear it, would no longer remain properly on his head, but always slipped down on his poll. Now the *right* testis had shrunk very far more than the left; and the *left* breast was larger than the right, as though each breast had sympathised with the testis of the same side; and the *left* half of the occiput smaller than the right.[d]

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[b] In the third volume of his large work, printed in 1818, and some years before this in his lectures, Gall declared, from numerous observations, that the fibres of the chorda spinalis, ascending from the genital parts till they reach the cerebellum, must decussate exactly like the anterior pyramids. Some years afterwards, M. Serres and M. Fleurens made the same remark, and contended for priority, not mentioning Gall. It is remarkable how many discoveries of Gall's that were denied or disregarded, have been since made by others, and even frequently contested by two parties, he and his labours being never once thought of. "The greater part of authors," says he, "who have treated of the same subjects as myself, subsequently to me, practise this same kind of generosity towards me." (l.c. 8vo. t. vi. p. 26.)

[c] l. c. vol. ii. p. 233.

[d] I took care that a cast of his head and bosom should be placed in the museums of University College and the Phrenological Society, and read an ac-

Other experiments have just been made by Dr. Budge of Altenkirchen also showing the decussation, and repeated so often that mistake was impossible. He laid bare the brain and testes in old cats, and, on irritating the right lobe of the cerebellum superficially, the left testis moved; but, on irritating the left lobe, the right testis moved: and so much as to rise to nearly a right angle with the chord, and the testis became more and more tense: deep irritation of the cerebellum had no effect.[e] On the other hand, pleasurable irritation of the genitals will excite desire; and, judging from all the other facts, we should say from exciting the cerebellum.[f]

In violent sexual excitement, the back of the neck is deeply flushed, and hot. Some animals feel the sexual desire at certain periods of the year only: and at this time the testes, and in some instances the vesiculæ seminales and prostate gland, enlarge very considerably; as in the male sparrow and frog. Gall found the cerebellum of birds collected at this season, broader and more turgid, and the corresponding prominences of the cranium manifestly greater than in those collected at the beginning of winter.

The facts adduced by Gall on these points in the third volume of his quarto and octavo work, are extremely curious, and similar ones, without end, may be found in works upon disease, military surgery, and physiology, from ancient times down to Magendie's *Journal* for 1822 and 1827. It occasionally happens[g] that apoplexy or other disease of the cerebellum is not attended

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count of him to the Phrenological Society. An account drawn up without the advantage of phrenological knowledge contains not a word of the state of the occiput or of the relative size of each breast and testis. (*Lancet*, Dec. 2. 1837.)

[e] Müller's *Archiv.* 1840.

[f] Desire is certainly appeased on the discharge of semen, but in all probability by the fulness of excitement and not by the discharge: for all men know that, however strong their desires for a day or more, these, if resisted, will subside just as though the semen had been discharged.

[g] Gall himself gives an instance, l. c. 8vo. t. iii. p. 365. sqq. We must remember what Gall says upon the possibility of other effects from injury of the cerebellum (*suprà*, p. 427. sq.). "The same part may have its general vital function and its particular animal function," — "the cerebellum may participate in the vital function of the medulla oblongata and spinalis, may give rise to disturbed motion when injured, and yet have its own particular animal functions."

by affections of the genitals: and it would be worth inquiring what is the exact seat of the lesion in such instances, since in Dr. Budge's experiments[h] the surface required to be irritated before the genitals sympathised; — a fact agreeing with my remarks at page 306. sq. *suprà*.

As puberty sometimes occurs extraordinarily soon, so does it sometimes, though more rarely, extraordinarily late. Professor Wilson knew a young man whose penis and testes at twenty-six were no larger than in boys of eight; at this time, however, they began to evolve, he had erections and emissions, fell in love, and in two years, *viz.*, when twenty-eight, they were as large as in other men, and he married and became a father.[i] Some women do not menstruate till between twenty and thirty.[k] Some children do not speak till several years old. Gall remarks that precocity or tardiness may in the same way be the lot of any cerebral faculty and its organ, just as of every organ throughout the rest of the body. Gessner, one of the best and most amiable poets of Switzerland, was declared by his preceptors incapable of any attainment when ten years of age. One of the most celebrated physicians of Berlin could neither combine his ideas nor speak at thirteen.[l] In fact, the natural growth and other changes of any organ or any number of organs may occur before or after the usual period.

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[h] These experiments should impress every person with the reliance to be placed upon Gall. He advances nothing lightly; and his genius, indefatigableness, forbearance, and truth, will be acknowledged more and more daily. Not to be well acquainted with his writings is a disgrace to every medical man of education, and a loss to every man. I never open them without finding something new or something that I had not so fully felt the force of before, — just as happens whenever I open Shakspeare: and Gall, no less than Shakspeare, should always lie upon one's table.

Burdach, without condescending to mention Gall's name, felt himself obliged to write the following passage. "The cerebellum is the part with which generation has close relations. When the procreating faculty is strong, the cerebellum and muscles of the back of the neck are very much developed. The back of the neck is very narrow in castrated men and brutes. Abstractions of blood from the occiput are more proper than from any other part to restrain immoderate desires. A wound at this part is often followed by impotence; suppuration or atrophy of the cerebellum by wasting of the testicles; and inflammation of it often occasions priapism. Serres has demonstrated by a number of cases that an effusion of blood at the cerebellum causes erections, sometimes accompanied by emissions, and sometimes continuing after death. Masturbation produces pains chiefly at the back of the neck. Venereal excesses often induce hæmorrhages, suppurations, indurations, and false membranes in the cerebellum. When hæmorrhage occurs during coition, it is usually in the cerebellum." (§ 564.)

[i] *Lectures on the Male Urinary and Genital Organs*, p. 424.

[k] Promiscuous connection generally prevents conception or lessens the disposition to it, while continued: yet has no effect upon menstruation.

Not only do instances of early puberty and full growth frequently occur, but likewise of deficient and exuberant growth.

Dwarfs are generally born of the same size as other children, but after a few years suddenly cease to grow. They are said to be commonly ill-shapen, to have large heads, and to be stupid or malicious[m], and old age comes upon them very early. Three foreign dwarfs exhibited about twenty years since in London, two men and one woman, had certainly large heads and flat noses, but in other respects were well made. The tallest of the three seemed a sulky creature, but the woman was very ingenious and obliging, and Simon Paap — the least of the three, appeared very amiable. He was 28 inches high, and 26 years old. They were not related to each other, and the relations of all were of the common size. Their countenances were those of persons more advanced.

The smallest dwarf on record was only 16 inches high, when 37 years of age.[n] I saw a female dwarf, named Crachami, said to be ten years old, who was well formed, but had the features of a baby, was only 19½ inches in height, and 5 lbs. in weight.[o] Her voice was that of an infant. To hear her speak, and see her walk, sit, and behave like a child several years old, was one of the most striking things I ever witnessed.[p]

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[l] Gall, l. c. 4to. vol. i. p. 17. sq.; 8vo. t. i. p. 194. sq.

[m] "It will not be easy to produce me an instance of any one giant or of any one dwarf perfectly sound in heart and mind, *i.e.* in the same degree with a thousand other individuals who are regularly constituted. Great mental weakness is the usual portion of giants, gross stupidity that of dwarfs." (Lavater, *Physiognomy.*)

[n] Haller, *Elementa Physiologiæ*, t. xii. lib. 30.

[o] See *Literary Gazette*, May 1. 1834.

[p] Among John Hunter's papers is a memorandum of a female at Norwich, 34 inches high. "She cohabited with a great fellow she called her husband and became pregnant. She went her full time, but, as might have been expected, from the smallness of the pelvis, the labour was difficult and it was necessary to open

The tallest person authentically recorded has never exceeded 9 feet, according to Haller. A young man from Huntingdonshire, also exhibited in London a few years back, was of remarkable height. Although only 17 years of age, he was nearly 8 feet. He had a sister of great height, and many of his family were very tall. He was, as is usual, born of the ordinary size, but soon began to grow rapidly. He appeared amiable, and as acute as most youths of his age and rank.

Giants and dwarfs happily seldom reach their fortieth year, and have not a very active cerebellum or organs of generation. As the period of growth is so short in dwarfs, and the period of childhood so short in those who reach puberty early, it is to be expected that their old age will be premature, — that their stationary period and decline will be likewise short.[q] Giants do not, like

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the child's head: after which the delivery was effected. The child measured 22 inches; so that if it could have stood upright in utero, it would have risen above its mother's head. The woman died four hours after delivery." (Mr. South, *Translat. of Dr. Otto's Compendium of Human and Comparative Pathological Anatomy*, p. 21. sq.)

[q] In the year 1748, Mr. Dawkes, a surgeon at St. Ives, near Huntingdon, published a small tract called *Prodigium Willinghamense*, or an Account of a surprising Boy, who was buried at Willingham, near Cambridge, upon whom he wrote the following epitaph. But whether it was ever engraved upon his tombstone I have not learned.

'Stop Traveller, and wondering, know, here buried lie the remains of Thomas, son of Thomas and Margaret Hall; who, not one year old, had the signs of manhood; not three, was almost four feet high; endued with uncommon strength, a just proportion of parts, and a stupendous voice; before six, he died as it were of an advanced age.

'He was born in this village, Oct. 31. MDCCXLI. and in the same, departed this life, Sept. 3. MDCCXLVII.'

Mr. Dawkes viewed him after he was dead, and says the corpse had the aspect of a venerable old man.

See also a description of him in the *Phil. Trans.* 1744–45.

This *perfectly authentic* case removes all doubts respecting the boy at Salamis, mentioned by Pliny (*Hist. Nat.* lib. vii. c. xvii.) as being four feet high, and having reached puberty when only three years old; and respecting the man seen by Craterus, the brother of Antigonus (Phlegon, *De Mirab.* c. xxxii.), who in seven years was an infant, a youth, an adult, a father, an old man, and a corpse.

Hopkins Hopkins, weighing never more than 18 lbs. and latterly but 12, died dwarfs, I believe, die from premature old age, but from mere exhaustion.

The Laplanders are one of the shortest races. Buffon says that their height is but 4 feet, and that their tallest men do not exceed 4½ feet.

The intellect acquires a great increase of strength towards the 20th year, as many must have noticed in themselves: and the developement of the forehead is proportional. The last molar tooth, called the wisdom tooth, is cut about this time at the two extremities of each gum, and often occasions great annoyance. The enamel of the teeth is worn away sufficiently for the bone to appear as a yellow line on the summit of the incisors, especially of the internal, at the 18th year: and at the 20th, as brown spots upon the summit of the canine and of the lower first molar, upon the outer point of the first upper, and upon the second upper and lower.

Growth proceeds very rapidly at the beginning of youth, so as to make up for the check which it had previously experienced; and perhaps four or five inches may be gained in one year. During an acute disease, it is often found, on recovery, to have proceeded very rapidly: and change of air appears sometimes to accelerate it. Females generally attain their full growth at about 18; males at 20 or 23. Five feet may be the mean height of a woman: five and a half of a man. The ordinary weight of either is about 130 pounds. "The epiphyses of the bones, hitherto distinct from their diaphyses, now become inti-

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of pure old age at seventeen; and one of his sisters, but 12 years of age, and weighing only 18 lbs. at the time of his death, had all the marks of old age. (*Gentleman's Magazine*, vol. xxiv. p. 191.)

At the *Hospice de Maternité*, a few years ago, a child is declared to have been born all wrinkled, and with strong grey hair on its head and chin: it appeared in good health, but its hands and feet were of double the usual length. (*Tablettes Universelles.*)

Tirrenus is said to have grown grey when five years of age (Strabo): a Mr. Waldkirch, a German senator, to have been grey in one half of his body almost as soon as born (Shenkius): and twins to have been born grey and have remained so through life (Stadler, *De Observationibus*). (Dr. Speranza, in Dr. Omedei's *Annali di Medicina*, Feb. 1832.)

mately united and in a manner confounded with them." Various bones unite.

The frontal sinus begins to be produced, as well as the nasal and maxillary sinus to obtain their due proportions. The chest and lungs expand; and grey, blue, or black spots are seen in the lungs. Respiration grows more extensive and slower; and the pulse descends to 80 or 75. The blood is rich in fibrin, bright, and very abundant. The body has the charm of youth, if not of beauty: for youth even without beauty is itself charming; though this charm must soon vanish, like the freshness of the newly gathered fruit or flower or of the leaves of a plant, or the delicious flavour of a newly killed animal.[r]

The revolution of puberty sometimes languishes for want of power in the system; and far more frequently in females, in whom the condition is called Chlorosis.[s] The want of strength may take place when it should begin or at any time during its course; and even a considerable time after its establishment, the genital functions sometimes fail and the whole body grows pale and feeble. An almost specific remedy for this want of power is iron in any form: and yet I every day see other remedies of no specific power given instead, and often indeed slight degrees of the disease and cases occurring at earlier or later periods than usual altogether mistaken, and patients allowed to languish for a year or two who might be cured with iron in a few weeks.

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[r] Belzoni, when in Egypt, found the Turks dress their mutton immediately after it was killed, before it had lost its natural warmth, "and in this way it has a particular flavour, quite agreeable to the taste." (*Narrative, &c.* p. 49.)

[s] Burdach makes the following remarks, § 556. II. 5°. "The sensibility of the female is particularly affected. She has pain in the lower part of the abdomen and back; a feeling of tension and pressure in the pelvis; of weight throughout the body, especially in the loins and thighs; lassitude, sleepiness, ill temper, anxiety and restlessness, morbid sensibility, a disposition to shed tears and then suddenly to have transports of immoderate joy. At a period when conscience is in general as yet but little developed, the obscure and vague sensations arising from a new direction impressed upon life may upset the character and give rise to strange and even criminal desires. Thus we occasionally see extraordinary disorders of sensibility:—a morbid sympathy, which causes convulsions to occur at the sight of them in another; extasy or external immobility with internal exaltation; catalepsy or a transient loss of volition, with the power in the muscles of yielding to mechanical impulses and of preserving, by a continued action, the situation in which they are put; an unusual developement or hallucinations of the senses, especially of smell and taste, which cause the most repugnant things to be agreeable; lethargy or a long and complete suspension of animal life; somnambulism, *an extreme susceptibility of animal magnetism* and magnetic clairvoyance, — a state in which, the spontaneous activity of the soul being suspended, the exaltation of general sensibility causes the latter to acquire the lucidity of the sensorial actions and places it beyond the limits of space and time assigned to all knowledge acquired by the senses. (Osiander, *Ueber die Entwickelungskrankeiten*, t. i. p. 6—60.)" The circumstances mentioned are all admitted in this country except the susceptibility of mesmerism. But the truth of it is equal to the truth of the rest. The ignorance of the British medical profession on this subject, while our Continental neighbours are so well

The female brain does not become so large as the male. Sir William Hamilton found the average weight of the Scotch male brain to be 3 lbs. 8 oz. troy; and of the female, 3 lbs. 4 oz.: one male brain in seven to weigh about 4 lbs.; only one female brain in a hundred to weigh 4 lbs.[t] Dr. Tiedemann allows that

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acquainted with it; the clownish obtuseness and obstinacy displayed upon it by many; and the ignoble fears and the unprincipled, contemptible, and selfish truckling of some who are convinced of its truth to the prejudices of those whom they ought to inform or disregard, no less than the vulgarity, malice, and bitterness of others, are a disgrace to the age, which nevertheless we glory in as enlightened beyond the days of our ancestors and purified by our broad and deep reception of humble and benevolent Christianity. At the same time, on so wonderful a subject, neutrality of opinion is all that ought to be expected before the phenomena are personally witnessed and honestly examined.

The sexual system of plants was known to the ancients, as appears in Herodotus, Theophrastus, Aristotle, and Pliny; yet, notwithstanding Zaluzianski, and a century after him Millington and Grew, had defended it in modern times, Tournefort *refused it a place in his system.* This was all very well. But Pontedera, *after carefully examining it,* pronounced it *chimerical;* and the very learned Dr. Alston, the Professor of Botany in the University of Edinburgh, *violently opposed it!* At present it may be mentioned without throwing people into a passion or subjecting oneself to the imputation of being whimsical, crotchety, or mad: and in fact to doubt it would excite a smile of compassion.

While I agree with Burdach as to facts, I reject his mysticism as Gall did, who, while quoting him (l. c. 8vo. vol. vi. p. 369.), is obliged suddenly to desist, saying, "Here he begins raving so absurdly about the universal soul of the world and about materiality transformed into spirituality, and spirituality transformed into materiality, that I cannot discover any sense or continue the quotation." I have seen nothing like a transit of "sensibility beyond the limits of time and space assigned to all knowledge acquired by the senses," nor have I seen any thing like action of mind without matter; — any thing beyond new states of the nervous system.

[t] Dr. Monro's *Anatomy of the Brain.*

the European male adult brain weighs from 3 lbs. 2 oz. to 4 lbs. 6 oz. troy: the female from 2 lbs. 8 oz. to 3 lbs. 11 oz. "I never found," he says, "a female brain that weighed 4 lbs." The female brain weighs on an average from 4 to 8 ounces less than that of the male; and this difference is already perceptible in a newborn child.[u]

5. The Adult Period is properly the whole of life after youth. But for convenience the term is often restricted to the period between youth and old age. There might be less confusion, were the term always allowed its full meaning, and the words virility, or manhood and womanhood, given to the period between youth and old age. Womanhood extends from about 18 to 40 or 45; manhood from about 24 to 45 or 48.

At about 30 in the female and at about 35 in the male, every part has generally obtained perfection of structure and consequently of function. The solids have their utmost solidity consistent with the perfection of function: the fluids their utmost healthy richness: the strength is at its height, in brain, muscle, and every other part. The cerebral and general corporeal characteristics of the individual are finished, so that what distinguishes him in mind, feature, and every thing else from all other individuals is complete. The shoulders and hips have attained their greatest breadth. Hair has appeared upon the scrotum and perinæum of the male, and upon the labia of the female; the odour of the genitals has increased: earthy matter exists in the pineal gland, and the brain has at length completed its size, though in some males it may continue to grow till even beyond 40, and consequently virility of intellect and feeling is established; the character is more serious. The upper and lower bony plates of the bodies of the pelvic vertebræ and the transverse processes are adherent about the 25th year: the coccygeal vertebræ are disunited till towards the end of virility. The frontal sinuses increase and continue to increase till death. The yellow line of the incisors widens, the exposed osseous substance wears down, and the crown becomes shorter, so that, about the 30th year, the permanent teeth are as much worn as the milk teeth were when they fell out.[x] After 30 in the female and 35 in the male,—the second half of this period, as some divide it, the freshness of youth vanishes, but the solidity of character greatly increases; the light form and the activity of youth decline, and fat accumulates on the trunk and especially on the abdomen, so that all but the spare have some rotundity, — some degree of "fair round belly."

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[u] *Phil. Trans.* 1836, Pt. ii.

[x] Burdach, l. c. § 560.

The generative power increases with all the rest. Men and brutes in their prime are more fruitful than in the early periods of puberty, and their offspring larger and stronger. At the first birth the full time is frequently not accomplished; and the breasts supply less and inferior milk: even the first eggs of birds are small.

The air-cells of the lungs, no less than the villi of the intestines, have become less numerous; and, as the cells are now also larger, the respiratory murmur, which in children is so loud that an equally loud murmur at other ages through disease is termed *puerile*, has much diminished. (See *suprà*, p. 206.)

6. Old Age. At about 35 the lower eyelid grows rather loose, and about 40 becomes wrinkled; and soon the skin beyond the outer angle of the orbit gives the appearance called crow's foot. This is accompanied by a little falling off and greyness of the hairs of the head, and stronger hints are given between the 45th and 48th year. The hair first grows decidedly grey in men generally about the temples. In some the change proceeds quickly; in some very slowly. In some the hair becomes at length perfectly white; in some it does not become of more than an iron grey till extreme old age; some soon after 20 years of age are grey, some reach 70 or 80 with only a sprinkling of grey hairs; at various ages some will have the hair of their head silvery and their eyebrows of a jet black. The hair generally falls off a little first at its lower part in front, and especially at the lateral portions; and, after a time, it becomes generally thinner every where except at the back of the head, and especially on the top of the head, which may become more or less bald. The baldness often is first complete at the posterior part of the top. Some young men are rather bald soon after 20; some few men of 80 have still thick hair: those with low foreheads usually retain their hair the longest. The skin of the hand grows loose, and age is well distinguished to an observing eye by the hand throughout life.

Between the 45th and 48th year, the memory of proper names becomes impaired; and then of common names: the sight then becomes long, so that writing and books, if not held farther off than was habitual, are indistinct, and this is usually more the case with one eye than with the other. Sexual desire is less urgent, the organs are less ready and their readiness is less lasting. At about 45 menstruation ceases; sometimes suddenly, sometimes by degrees; sometimes it has alternations of excess in quantity and deficiency in frequency, or becomes irregular in frequency,—dodging, as women say, or in quantity, or in both. The change may be seven years in taking place, and the woman tormented all the time with affections of the head, smothering heats, faintnesses, and various other annoyances.

As age advances, women sometimes have hair grow upon the chin[y]; and birds, after ceasing to lay eggs, frequently lose the feathers peculiar to their sex and acquire those characteristic of the male[z], as well as spurs, according to the remark of Aristotle, combs, and wattles. Mares will acquire the mane of the horse, female giraffes the coat of the male. The doe will acquire the horns of the stag and roebuck. An old woman's voice always grows gruff. I recollect hearing a convent of old nuns in Bologna at vespers and should have mistaken them by their voices for old men, had I not been assured that the unseen useless devotees were all old women.

After passing the period of the cessation of the catamenia, women often become fixed in good health, being troubled no longer with uterine disturbances of their system; and, though they steadily decline, the invasion of age may be very gradual, and their health better than for very many years before. In truth they become more bold and bustling, like men; while old men are less energetic, and perhaps called old women.

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[y] "See J. Bürlin, *De Fœminis ex Suppressione Mensium barbatis.* Altorf. 1664. 4to."

[z] Blumenbach, *Comment. de Nisus Formativi Aberrationibus.* Gott. 1813. 4to. p. 8. This change sometimes arises from ovarian disease. (*Phil. Trans.* 1827.) Sir Everard Home mentions a duck which, when 8 years old, not only ceased laying and acquired the male plumage, but repelled all drakes, and did its best to tread ducks. (*Phil. Trans.* 1797, p. 174.) Here the properties of the cerebellum even had changed. The ovaria of hens will occasionally grow narrow and bend on themselves, like a vas deferens: and the larynx so change that the old creature crows like a young cock.

The progress of old age[a] may be very slow, indeed imperceptible, except in the countenance, hand, and hair, and in a number of little things appreciable by the individual himself and those who act with him or have opportunities of close observation, till about 60 years of age; after this, the brain rarely executes any thing original. In instances of decided genius, the full glow is so remarkable, that a falling off of intellect and feeling is readily discernible and the difference of the mind may at an early period be perceived. The power of intellect is now exerted on things formerly learnt, and chiefly through the facilities given by habit. The elderly man no longer likes new lights in science, nor improvements in institutions and methods. If he is a physician, he scorns new-fangled remedies and new revolutionary discoveries in physiology and pathology, and tells of the number of follies he has seen prevail and pass away in his time[b]: he acquires more confidence daily in nature's power of curing disease, being left daily more below the point of present knowledge, practising more and more feebly and uselessly, but more greedy than ever of fees, as though he was more informed and did more for his patients than ever. His feelings grow blunt except his appetite for food and money: remembering his former pleasures, and being insusceptible now of what he once was, he praises the past only and condemns the present state of things, — "*laudator temporis acti.*"[c]

The solids grow drier and more rigid; shrink in bulk, and become rarer in texture: and they are less excitable, and less fit for function. Their colour alters, and, since such gross changes are manifest to us, no doubt most delicate changes in texture and composition, beyond the powers of analysis and optical aids hitherto employed, also occur, even before the grosser are discernible; such as even in animals living in fluids and in leaves still full of juices determine the death or separation of individual parts. The intimate composition and organisation of different animals and plants must be differently modified altogether and be capable of different degrees of duration, so as to break up at definite periods in each species, variety, and individual, when no extrinsic cause puts an end to life before the arrival of the inevitable term. The original composition of the being involved powers of certain changes in composition and of organisation, and these involved others; all these peculiar conditions comprising, of necessity, in their nature, peculiar powers of function. But the successive changes at length cease to be improvements; they are inferior to each other and such as give less aptitude for function; and intimate composition and organisation at length become incapable not only of function, but of farther continuance, and the series of possible changes is exhausted.

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[a] "J. Bern Fischer, *Tract. de Senio ejusque Morbis.* Ed. 2. Erf. 1760. 8vo.
Benj. Rush, *Med. Inquiries and Observations,* vol. ii. Philad. 1793. 8vo. p. 295. sq.
Burg. W. Seiler, *Anatom. c. h. Senilis Specimen.* Erlang. 1799. 8vo.
Const. Anast. Philites, *De Decremento, seu de Marasmo Senili.* Hal. 1808."

[b] Those men in the prime of life, who do the same, must in this particular be considered in premature mental senility: and those students who suffer their teachers so to spoil their minds may be compared to children enfeebled by the emanations of the *old women* with whom unfortunately they *sleep.* (*Suprà,* p. 958.)

[c] Bishop Watson, who gained immense applause for his *Apology for the Bible* and his *Chemical Essays,* when told twenty years afterwards of the discoveries of Sir Humphry Davy, always sneered at the "new-fangled doctrines," and professed himself contented with chemistry as it was in his younger days. (See *Tait's Magazine* for example.)

In different organs the original composition, and thereby minute powers are differently limited: some arise early, some late; some arrive at perfection soon, some late; some have few changes, some many; some exist only for a short time, their local old age, literally speaking, being arrived at speedily, some for a great length of time: so that while some parts flourish till general old age comes upon the whole system of them, others arise, flourish, and decay, long before, and some even in the earliest periods of life.

As age proceeds, separate adjoining parts are disposed to coalesce; the serræ of sutures and at length the sutures themselves vanish. Transformations to harder structures occur;—muscular parts may become tendinous, fibrous membranes cartilaginous, and cartilages bones: and bone is often deposited in various parts of the cellular membrane, and under serous membranes and the lining membrane of the heart and arteries. Thus, before senile decline in power, composition, and in minute structure arrests function, there arises a disposition to painless disease of structure, such as induration and opacity, slowly unfitting parts for use. The arteries, capillaries, or the valves of the heart, for instance, may ossify: the lens become opake. As if to co-operate with the decline of the organs of sense, the avenues to the senses become overshadowed by hairs: the eyebrows, the hairs around the opening of the meatus auditorius, and those of the nostrils, grow very thick and long. The portion of the cornea nearest the sclerotic grows opake, forming a white ring, called arcus senilis.

The pulse becomes slower, and at length irregular, and then it generally ceases to grow slower[d]; and from the thickening and induration of the arterial coats it is larger, and apparently firmer. The arteries, before extreme old age invades, are heavier. They contain less blood, and the whole amount of blood and other fluids is less, and less blood penetrates into the smallest vessels; but the venous blood becomes more abundant, and, from the debility, venous congestion is common. The blood has less fibrin; and the serum is less coagulable, from containing less albumen.

The temperature is not so well maintained. The vivacity of colour declines in all the organs, and they become pale, or of a dirty hue: a pale white yields to yellow or grey; a bright, to a dingy, red: — all evidences of excessively minute changes in composition, while neither the chemist might discover change of composition, nor the microscopist change of organisation.

Nutrition is imperfect and altered. Not only do all the parts, even the bones, shrink and grow lighter and drier[e], but fractures will not unite nor wounds heal so quickly as before[f]; ecchymosis,

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[d] The sap moves much more slowly in old plants.

[e] See Blumenbach's osteological work upon the remarkable wasting of the bones of old men, p. 36. sq.

"Joach. H. Gernet, *De Siccitatis Senilis Effectibus.* Lips. 1753. 4to."

[f] Throughout life a deviation from uniformity of action, and even without deviation the least call for more exertion than usual, is followed by unpleasant results, whether as regards the functions of the brain or of any other part, if the powers are feeble, either by nature or through unfavourable circumstances: and it then is proved that the appearance of power depended solely upon the habitual uniformity of its exertion. Dyspeptic persons should remember this in regard to their diet and the delicate in regard to all efforts: and people of mental mediocrity should submit to the evidence of this test before they indulge in the conceit that they are fit for greater things than they have ever done.

The converse also is true. Where there is great power or great predisposition to action, the action or phenomenon occurs without evident exciting causes. When hooping cough exists, numberless circumstances may excite a fit, but the force of the predisposition will excite fits from time to time of itself. Where a as well as gangrene, is readily induced: and the bones, teeth, and blood-vessels grow brittle and fragile. The very villi of the intestines lessen. The absorbent vessels shrink and are less active; —effusions, so readily induced by the debility of the blood-vessels, are not quickly taken up. The absorbent ganglia grow hard and dry.

The teeth, at 70, have half their crown worn down, and the exposed cavity is filled with a new osseous deposit, producing a brown or reddish yellow spot on the top; they are no longer liable to caries; they die and fall out in succession. The emptied alveoli shrink and fill with an osseous substance; their border is absorbed and its absorption begins even before the teeth fall out. The jaws consequently lose in depth: whence the hard palate is no longer arched, and the foramen of the chin lies close to the upper edge of the lower jaw. The lower jaw bone grows also shorter and its ascending branch lower and more oblique: so that the angle is more obtuse, the articular process lower than the coronoid, and the joint on a level with the upper gum; the external surface of the lower jaw below the chin is no longer perpendicular, but oblique; the two jaws scarcely touch except where the molares lie; and the lower jaw projects beyond the upper.[g]

From the diminution of the number of blood-vessels, parts, which before could be injected red, can now no longer be coloured, and parts attached by them readily separate; thus the dura mater is easily detached from the cranium. Articulation, mastication, and deglutition, like all other muscular actions, become weaker. The air-cells of the lungs become still less numerous and larger, probably from the thinning and absorption of their walls, for these two changes produce the same effect in the corpora cavernosa of the penis; and the lungs grow lighter[h], but this is partly owing to their resembling every other part in containing less blood. The body gradually loses in its stature.

7. At from 70 to 75 in the female, and from 75 to 80 in the male, the age of Decrepitude begins. "*Omnia in pejus ruere.*" The blood-vessels and absorbents have so diminished in number; the

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cerebral organ of feeling is strong, it impels to violent action from time to time without any unusual external exciting causes being applied to it.

[g] See Burdach, § 587. [h] See *suprà*, p. 206.

canals in every dimension; the brain, chords, nerves, ganglia, muscles, tendons, bones, and every apparatus of sense in size and proportionate weight; and the fluids correspondently in their richness and quantity, that an old person is lifted with ease, and any one not aware of the circumstance will be greatly struck with the lightness of an old woman whom he takes in his arms or of an old hen in a poultry yard. "The brain, after having remained stationary for 10 or 20 years, begins to decline and lose its fulness and turgescence, and, in the same proportion, its activity. But all the cerebral parts do not waste equally; the anterior inferior shrink sooner than the others; whence the faculties dependent upon them, the memory of names among others, are the first weakened. Successively all the cerebral parts change more or less; the man loses the power of combining a large number of ideas, of seizing the relations of objects and the connection of cause and effect. New impressions slide, as it were, off the exhausted brain, and the old man remembering no longer the occurrences of the previous day, takes delight in diffused and everlastingly repeated recitals of the adventures of his youth: his state grows worse and worse, till nothing is at last left but inert cerebral fibres, insensibility, and dementia."[i]

[i] Gall, l. c. 4to, vol. ii. p. 406. sq.; 8vo. t. ii. p. 431. sq.

It is now universally admitted that the soft parts model the hard. Thus the interior of the skull has the shape and dimensions of the respective parts of the brain which it incloses; and even the blood-vessels imprint it. Now, "at the approach of old age all the nervous system begins to lose its fulness, and consequently its activity. Throughout the body, the nerves shrink, the cerebral convolutions grow narrow and flat; what were their prominences become flat and depressed; they separate from each other; their interspaces widen: in short, the whole brain lessens." (Gall, l. c. 4to. vol. iii. p. 28.; 8vo. t. iii. p. 47. sq.) The skull is necessarily influenced by these changes. "The internal plate follows the shrinking brain: the bony substance, while it is depositing, must still mould itself upon the brain;" and thus "the capacity of the skull lessens proportionally with the brain." (4to. vol. iii. p. 29.; 8vo. t. iii. p. 50.) The skull grows lighter, like every other part: but at the same time thicker and more spongy.* For ge-

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* When Gall first declared this, he was pronounced "very bold for uttering such absurdities before enlightened anatomists and doctors." (4to. vol. iii. p. 27. sq.; 8vo. t. iii. p. 48.) But he multiplied his observations in cemeteries, museums, and dissecting-rooms, upon skulls proved by the jaws to be old. At length he found that Voightel (*Handbuch der Practischen Anatomie*, p. 274.) said the same

Not only do the genitals shrink very considerably, so that in this respect the sexes differ less and less; but the aspect of the face and the whole frame becomes so similar in the sexes, that the face and hand, and indeed the trunk of the two, might readily be undistinguishable, to a common observer, as in infancy: while old women's chins grow a little hairy, old men's beards grow very smooth, and the feebleness of his mind causes an old man to be said to have become "quite an old woman." The face is ash coloured and wrinkled: the skin of the hands loose, and so transparent that the tendons and other parts below it are visible. From the blunted condition of the senses, the apathy of the brain, and the weakness of the muscles, cleanliness is not regarded as before; and an old person, if not carefully attended, is very dirty. The hands and legs tremble in exercise; he walks slowly, and to run is impossible, so that he is readily run over in the streets; he stops from time to time; requires the aid of a stick, and at length the support of an attendant also: he is too weak to hold up his head or his trunk. The voice grows tremulous and shrill; his

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nerally the head does not grew smaller; but, while the internal table shrinks, the diploe increases and maintains the dimensions of the external. The frontal sinus necessarily enlarges; and the superior internal layer of the orbitar plate even separates from the inferior. In spite of these facts, Gall found no one allow that the brain lessened in old age.

In some cases, little diploe is deposited, so that the skull grows thinner, the external table follows the internal, and the head lessens and grows much lighter. In extreme old age, the excess of diploe is sometimes at length absorbed again in certain parts, and the external table wastes; so that the thinnest parts become transparent and not thicker than paper, and the least pressure may produce depression.

Gall adds that the variable thickness of the skull in old age prevents any certain inference respecting the state of the brain. (4to. vol. iii. p. 31.; 8vo. t. ii. p. 54.)

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thing: and that Walter, who had *fiercely* contradicted him, described (*Museum Anatomicum*, vol. ii. p. 36.), the head of a man above 60 years of age, every bone of which was thick, light and not very firm; and the head of a woman above 80, with bones thick and spongy, and so light that it weighed altogether but 14½ ounces. Bichat mentions this fact as ordinary, saying that "the cranium acquires a great and constantly increasing thickness by age, while other bones diminish." (*Anatomie Descriptive*, p. 58.)

> "Big manly voice,
> Turning again towards childish treble, pipes
> And whistles in its sound."

The decay and helplessness of one part coincides with that of others, so that it is powerless when the failure of others would render its power useless. The intellect becomes incapable of understanding any thing new; the feelings are so blunted that spouse and children are lost without great suffering. Much of the time is now spent in sleep. Emaciation increases, and at last we are

> "Sans teeth, sans eyes, sans taste, sans every thing."

In this miserable state of wreck, the power of the brain called mind, like the power of all other organs, and every organ, are reduced to the lowest point compatible with life, and, without Divine assurance to the contrary, must indicate a final extinction, since a gradual expansion of intellectual and high moral faculties might be expected the nearer our entrance into a higher state of existence, and not a steadily increasing decline into childishness, incapacity, and absolute fatuity — *dementia senilis*, as it is technically called, in which no evidence can be appreciated, no views conceived; and the longer life is pushed,—the nearer to another world the individual arrives, the more fatuitous does he grow, — the more and more below the brute creation. Though few live long enough to die thus fatuitous, it must be remembered that the faculties of the old are always more and more impaired and employed upon old experience without the power of advancing, and that, among those who perish in the vigour of their minds, they who are not cut off suddenly, nay even they who become very acute before death, generally become delirious or unintelligent ultimately before they expire.[k]

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[k] Lord Bacon, in his *Historia Vitæ et Mortis*, contrasting youth and old age, says that, whereas in youth were *pudor et verecundia*, in the old man *obduruit;* in youth *benignitas et misericordia*, in the old man *occaluit;* in youth there is *æmulatio laudabilis*, in the old man *invidia maligna;* in youth religion and devotion, in the old man *defervescentia in pietate*, from his charity having cooled, his long converse with misfortune, and his difficulty of believing; in youth liberality, beneficence, and philanthropy, in the old man *avaritia et sibi sapere et consulere;* in youth confidence and hope, in the old man *diffidentia et plurima habere pro suspectis;* in youth obligingness and deference, in the old man *morositas et fastidium;* in youth sincerity and openness, in the old man *cautio et animus tectus.* Old men *in garrulitatem proficiunt et contestationem*, for which reason the poets turned

When things are at this pass, the power of life at length rapidly declines. No condition of living bodies, animal or vegetable, can

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old Tithonus into a grasshopper.—People thoroughly excellent by cerebral organisation remain very excellent in old age; but my experience assures me that the majority of men in many points of their character even yet are unprincipled and wicked, or weak, either by nature or from their organisation being of a middle character and therefore dependent upon external influences for its working and thus having yielded to the evil influences which unfortunately are still the most powerful. The bad by nature will be bad to the last; but for the middle class of minds a virtuous and rational previous life and an habitual just view of ourselves and of the whole of this world are the best preservative against the faults of old age. To expect any further solid reformation in the old age of vicious or contemptible persons, than what the enfeebled force of the feelings necessarily comprises, is hopeless. As far as the adage is true, such as the boy was such is the man, it is true that such as the adult man was such is the old man; for habit has established its sway. While we are in the vigour of life, therefore, we ought to habituate ourselves to the most scrupulous integrity in even the minutest matters, to benevolence even in manner to our fellow creatures and all the brute creation, to humility and an honest appreciation of ourselves and others, and to a rational view of the sources of true happiness,—being indifferent to titles and posts of honour, except so far as they are the reward and indicative of sterling merit in the individual possessing them, and convinced that these are far less valuable than the deserving them,—despising popularity unless the result of intrinsic desert only, and valuing the poorest person of talent or integrity,—indifferent to censure and abuse when our reason and conscience tell us that they are undeserved,—despising all waste of time in personalities and vulgarity and the littlenesses of coteries and knots of persons such as exist in all bodies of men, even the scientific and religious,—convinced that happiness consists in the possession of, or in honest industry to procure if we are not posssessed of them, the means of subsistence and competency and a certain amount of leisure for intellectual, refined, and disinterested pursuits, in the study of the knowledge of nature, in improving our feelings, in doing good to individuals, but especially in improving the condition of society, adding, if we can, to the means of art and to the general stock of knowledge, so that in old age we shall from habit be delighted to know that others in the full vigour of life are enlarging the bounds of art and science and increasing the happiness and dignity of the species, instead of stupidly thinking that all was perfect when we were young, and from habit be amiable and rational, looking at our decline and waiting for our death, as ordinations of nature, with placidity and resignation and hopes for the happiness of those who are to carry on the world after us. Such old persons I have known, still affectionately loving their family and friends, and the contemplation of them is delightful.

While the wretched state of civilisation which prevailed in all antiquity still prevails, even in the most civilised countries: while the arrangements of society cause the majority to live in excessive toil, with deficient food, and endless unwholelast beyond a definite time; and, when it is not preparatory to a fresh developement, so that on its declining a new modification

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some and demoralising circumstances, and a bad education or none: while too many who have all the means of health and happiness have false notions of the sources of happiness, and are imperfectly educated, delighting in what is trumpery instead of what is intellectual, noble, and worthy of a rational being's desire: while morality is founded, not upon the principle that that is virtuous which produces the greatest happiness of the greatest number (see *suprà*, p. 357. sqq.), and that vicious which produces more misery than happiness to the greater number*, (not to suppose these the results of virtue and vice would be to insult the Creator,) happiness being by nature "our being's end, and aim," so that we should be virtuous for the same high and godlike reason that a benevolent creator must be virtuous,—because he feels it right in itself; but founded over the greater part of the earth upon superstitious and often revolting fancies and selfish hopes and fears, the evidence of the grounds of which not one in ten thousand ever thought of weighing or has the information and intelligence to weigh properly, (and many a one who founds or pretends to found his morality on a basis of this kind is shocked or hypocritically pretends, in the midst of conduct which proves him a stranger to nobleness and virtue, to be shocked with the very best men who are virtuous for other reasons than he himself, as though God does not "prefer

"Before all temples the upright heart and pure,")

and waste their time in disputing upon their fancies of tradition and mystery, whereas they could all agree as to what is virtuous thought and action, and in acting accordingly: while all improvements of institutions is opposed, although fresh arrangements must be demanded in different stages of society, according to the analogy existing in all parts of nature, and just as organisation changes at different periods of the developement of animals:—while such is the state of things, all must appear vanity to those who thoroughly mingle with the world and join in its unintellectual, empty, and selfish pursuits. The sensual and showy Hebrew king, with his strong understanding, pronounced at last all to be vanity: and the vain and mean modern with his gigantic and rich mind pronounced human life to be not "aliud quam cumulus et accessio peccatorum et ærumnarum." But men with a better cerebral organisation, leading virtuous, beneficent, and intellectual lives, keeping themselves unspotted from the world, and mixing with it so as scarcely to be a part of it, find much happiness and satisfaction, and hope that a far higher point of civilisation will one day be obtained, in which health will be insured and solid happiness established, and those who would be happy but for the wickedness and folly of others and the infirmities of our bodies will have then happiness far less alloyed by these causes.

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* On this subject, see an excellent pamphlet entitled *Observations on the Foundation of Morals, suggested by Professor Whewell's Sermons on the same Subject.* By Eugenius. Longman and Co. 1838.

of composition, organisation, and properties, takes place, its cessation is necessarily death.[l] The termination is occasionally very slow; but not unfrequently rather sudden. Whenever strength is low, whether after starvation, excessive evacuation, continued irritation, or under the influence of a noxious agent, the highest hopes of recovery are often blasted by a sudden cessation of life when improvement had reached a certain point and no alteration for the worse had taken place for some time. The extreme debility of old age often ends in the same sudden way. The explanation probably is that, where the powers are so low, the slightest causes of exhaustion or difficulty tell,—causes sometimes inappreciable: but the act of turning in bed, the change of being raised, nay the loss of tension from a discharge of solid, fluid, or gas from the alimentary canal, has been known sufficient: and so might a slight and unnoticed emotion of the mind. Possibly excessive debility may be subject to sudden droopings independently of sudden calls upon the powers.

Just as we saw that various changes occur, co-operating with decay in lessening the functions of individual parts, so death in old age usually occurs before the system is completely decayed.[m] The tendency to structural disease is greater and greater as age advances[n]: and, when age is much advanced, any acute affection, though not violent, is often sufficient rapidly to exhaust the system; so that a very old person's life is one of the greatest uncertainty.

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[l] " G. Gottl. Richter, *De morte sine morbo.* Gotting. 1736. 4to.

J. Oosterdyk Schacht, *Tr. qua senile fatum inevitabili necessitate ex hum. corp. mechanismo sequi demonstratur.* Ultraj. 1729. 4to.

Matt. Van Geuns, *De morte corporea et causis moriendi.* LB. 1761. 4to. reprinted in Sandifort's *Thesaurus,* vol. iii.

C. G. Ontyd, *De morte et varia moriendi ratione.* Lugd. Bat. 1791. 8vo.

Curt. Sprengel, *Instit. Medic.* t. i. Amst. 1809. 8vo. p. 289. sq.

See the successive progress of the phenomena of death observed by the individual himself, a man of middle age, dying of dysentery, in Moritz's *Magaz. zur Efrahrungs-Seelen-Kunde,* vol. i. Pt. i. p. 63. sq."

[m] The circumstance of brutes ill treating and bringing death upon any one of their companions who is diseased, wounded, or nearly worn out with years; and of parasitic animals often swarming in bodies enfeebled from disease, are analogous facts; illustrating the Eastern saying, " from him that hath little shall that little be taken."

[n] There is a great tendency, in this climate at least, to an atonic sub-inflammatory state of the mucous membranes exposed to the air; so that the eyes are gummy and watery, the nose very moist, and there is a cough and expectoration —senile catarrh, whence most old people have short breath, cough, and "*pituita molesta.*"

"It is scarcely possible to define the natural *period* of life, or, as it may be termed, the more frequent and regular limit of advanced old age.[o] But, by an accurate examination of numerous bills of mortality, I have ascertained a remarkable fact — that a pretty large proportion of Europeans reach their *eighty-fourth* year, while, on the contrary, few exceed it."

The ordinary limit of life is from 70 to 84 years. But there is great diversity in the period of old age and natural exhaustion. Some are hale and hearty at 70. Some are feeble and decayed at 65.

Our countryman Parr married when 120 years of age, retained his sexual power till 142, and died at 152 from plethora, induced by a change in his diet.[p] Harvey, who dissected him, found no decay of any organ[q], and, had not Parr become an inmate of the Earl of Arundel's family in London, he probably would have lived many years longer. His soft parts were juicy and flexible, his cartilages unossified; nor was there diseased ossification or obstruction any where. A Pole, near Polozk, married for the third time at 93, and got children; in 1796 he was well and 163 years old. His eldest grandson was 95, and his youngest son was 62. A Norwegian named John Surrington died at 160, his eldest son being 103, and his youngest only 9. Our countryman Jenkins, who lived 169 years, and swam well when 100, is, perhaps, the greatest authentic instance of longevity.[r]

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[o] "Among other well-known treatises on this subject, consult J. Gesner, *De termino vitæ*. Tigur. 1748. 4to. reprinted in the *Excerptum Italicæ et Helveticæ litterat.* 1759. t. iv."

[p] At 105 he did penance in a white sheet for an illicit amour, which physiological fact John Taylor the poet, in 1635, immortalised in the following delicate rhymes: —

"Fair Catherine Milton was this beauty bright,
Fair like an angel, but in weight too light,
Whose fervent feature did inflame so far
The ardent fervor of old Thomas Parr,
That for love's satisfaction 'twas thought meet
He should be purged by standing in a sheet;
Which aged he *one hundred and five* year,
In Aldersbury Bury's church did wear.
Should all that so offend such penance do,
Oh! what a price would linen rise unto,
All would be turned to sheets, our shirt and s———,
Our table linen, very porter's frock,
Would hardly 'scape transforming."

Eccentric Mirror, vol. i.

[q] *Phil. Trans.* vol. iii. 1699.

Longevity, like every other quality, frequently runs in families. It is usually much disposed to by early rising and matrimony[s]: early rising implying freedom from nocturnal excesses, and matrimony giving more advantage from steadiness and domestic joys than disadvantage from anxiety and domestic troubles.

After the age of 45, more married men survive than bachelors: of 100 married men, 27·2 reach 70 years of age, but only 5·7 bachelors. M. Benoisten thinks that at 20 the life of a married man is worth 9 years more than that of a bachelor. The advantage is not quite so great on the side of married women over spinsters.[t]

The natural as well as actual duration of life varies in different countries. Buffon writes that in the American Indians the hair never becomes grey nor the skin wrinkled, and that many Mexicans, especially females, reach their hundredth year and preserve their muscular force till death. The Laplanders and the people of the northern coasts of Tartary, he also remarks, though living under ground during winter, and in the midst of smoke during summer for the purpose of keeping off the gnats, are seldom sick, and live to an extreme old age, the old being scarcely distinguishable from the young.

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[r] Bacon, Hufeland (*Macrobiotik*), Neuman (Leipzig), Mr. Easton of Salisbury in a work on longevity, and Dr. Pritchard, have collected many examples of extreme longevity.

A Scotchman named Kintingern and a Hungarian named Czartan are said to have died at nearly 180. (Burdach, § 623.)

John Rovin and his wife are said to have died in 1794 at 172 and 164; a mulatto at Fredericktown, North America, in 1797 at 180; Peter Torton in 1724 at 185; St. Mongah or Kentigen in 1781 at 185. (Dr. Pritchard's *Researches into the Physical History of Mankind.* 1836. vol. i. pp. 121—125.)

[s] See an original and beautiful *Account of the State of the Body and Mind in Old Age*, in the *Med. Inquiries and Observations* (vol. ii.) of that interesting writer Dr. Rush.

[t] *Bulletin Médicale Belge.*

Life is often protracted very long after the teeth have fallen out and the hair has turned grey from age.

Sometimes the reverse happens:—old age comes upon the body at large, while some parts scarcely change. Thus I have known a person of 90 see well: one of 80 have an excellent head of hair, and not at all grey; or with all his teeth, and in perfect condition. Hair turned grey, however, grows as well as hair of its previous colour: and young persons sometimes have all their hair grey, or portions of it grey in the midst of hair of good colour. Menstruation has continued regular till the 70th year[u]; and women have lain in at 54.[x] Starke mentions a woman who ceased to menstruate at 46, but began again at 59, and then produced and suckled a healthy child, and died at 84.[y] In 1830, a woman of 94 was living at Florence who had menstruated from her 15th year uninterruptedly, except for 8 months when 53 years old.[z]

Dr. Rush gives a striking illustration of the weakness of impressions made in advanced life, while those of earlier date are well remembered, in the instance of a German woman who had learned the language of the Americans when 40 years old and, though still living in America, had forgotten every word of it at 80, but talked German as fluently as ever. Bishop Watson's father married and had a family very late, and when extremely aged would twenty times a day ask the name of the lad at college, though he would "repeat, without a blunder, hundreds of lines out of classic authors."[a] My own memory reaches back to two years of age: a celebrated maiden authoress tells me she can remember to a rather earlier period.

The system sometimes makes an effort at renovation in extreme old age, there being an original power of one more change than is ordinary. I myself have known several old persons cut new teeth, and the *Philosophical Transactions*, the *German Ephemerides*[b], Van Swieten's *Commentaries*, and other works, record many similar facts,—even that of a complete third set.[c] Dr. Rush mentions an old man in Pennsylvania who at 68 lost his sight and remained perfectly blind for years, though otherwise in complete health; at 80, he regained his sight spontaneously without any visible change in the eyes, and could see as well as ever in his life at 84, when the account was written. Dr. Mason Good saw a lady who at an advanced age cut several new teeth, and threw away her spectacles after using them for twenty years, and read the smallest print of newspapers; and another who, with her new teeth, completely recovered her hearing, although she had for many years been so deaf as to be obliged to feel the tongue of her hand-bell for the purpose of ascertaining whether the bell rang or not. In the *Philosophical Transactions* a physician mentions that his father cut two new teeth, which afterwards dropped out together with the rest, when in two years fresh ones appeared, and he at length had an entire new set, and his grey hair turned black. The grey hairs of some very old people have become brown or black.[d]

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[u] *Phil. Trans.* 1713.

[x] *Edinb. Annual Register*, vol. ix.

[y] *Archiv für die Geburtshülfe*, vol. iv. p. 185.

[z] *Annali Universali*, 1830, p. 595. Her brother died at 106; her paternal grandfather at 109 and maternal at 89. She married at 15; menstruated for the first time in the 3d month, and became pregnant in the 4th, after her marriage; and had 3 children in 5 years. Three chickens, 5 or 6 lbs. of roast meat, and 20 oranges or peaches, were just enough for her breakfast. She had violent headachs, which were repressed by shaving the head, but always returned when the hair was 2 inches long.

[a] *Anecdotes of the Life and Writings of Bishop Watson, &c.*

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[b] One man 118 years old cut a complete front set with excruciating pain, and was seen at Clives two years afterwards, in 1666. (*Ephem.* dec. ii. ann. 3. p. 57.)

[c] John Hunter saw such an instance. (*Nat. Hist. of the Teeth.*) This was in a female, as I believe is more frequently the case.

[d] See examples in Sir John Sinclair's *Code of Health and Longevity*, and the *Dictionn. des Sciences Médicales*, art. *Cas rares.*

I need scarcely observe that the height and the age of men at present are the same as they were in ancient times. It is a common custom to magnify the past. Homer, who flourished almost three thousand years ago, makes his heroes hurl stones in battle which

——— *οὐ δύο γ' ἄνδρε φέροιεν*
Οἷοι νῦν βροτοί εἰσι. (*Iliad*, lib. v.)

Yet the giant who was the terror of the Israelites did not probably exceed nine feet in height, and it was to David who slew him and flourished but a little more than a century later than Homer's heroes that Barzillai thus excused himself for not visiting the royal palace at Jerusalem:—"I am this day fourscore years old; and can I discern between good and evil? can thy servant taste what I eat or what I drink? can I hear any more the voice of singing men and singing women? wherefore then should thy servant be yet a burden unto my lord the king?" (2 *Samuel*, xix. 35.) Moses lived five hundred years earlier than David, and if most biblical scholars are correct in ascribing the 90th psalm to him, he writes,—"The days of our years are threescore and ten: and if by reason of

Baldness has ceased after 30 years in one person[e], and in another at 70.[f] I attended a middle-aged lady for pompholyx diutinus whose hair had turned grey, but it became of a chestnut colour during my attendance, although the disease was severe and almost uncontrollable.

Precocity of any part has no tendency to enlargement of its bulk or powers beyond those of ordinary persons. The affair is merely one of time. The last precocious boy mentioned at p. 1010. was 3 feet 2 inches in height when 3 years old, and attained 5 feet at the end of his 6th year: but was not taller at 22, when his appearance was in all parts like that of other men of his age.[g] Precocity of general intellect often wears children out; and such should never be stimulated to learn, but kept back, as the excitement of their brain drains the rest of the body of its powers, and the brain itself perhaps falls into disease, — palsy, apoplexy, fatuity, &c. To allow a single precocious faculty, as that of music, full play is by no means so injurious. But young prodigies are unnatural, and not to be admired. Precocity of any organ or function may be followed by proportionally early decay or not: just as the part may have a natural tendency to flourish a short or a long period, independently of the time at which its full developement may take place.

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strength they be fourscore years, yet is their strength labour and sorrow: for it is soon cut off, and we fly away." But Bauer contends that this psalm belongs rather to the age of David and contains internal evidence that it could not have been written by Moses.*

[e] Schurich, *De Calvo post* 30 *Annorum Decursum comato. Misc. Acad. N. Curios.* dec. iii. ann. 7. and 8. p. 191. Otto, l. c.

[f] *Observat. sur des Cheveux et deux Dents revenus à un Homme de* 70 *ans; Mém. de Paris*, 1703. Otto, l. c.

[g] Mr. South's notes to his translation of Dr. Otto's *Compendium of Pathological Anatomy*, p. 25.

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* *Theology of the Old Testament*, p. 68. Extracted and translated from the *Theologie des Alten Testaments* of Georg Lorenz Bauer, Professor of Oriental Languages and of Logic at Altdorf. London, 1838. 8vo. published by Fox, Paternoster Row.

On the ground of a tradition of the Rabbis that God created Adam 900 cubits high, but cut him down after he sinned, the Academician Henrion contends that Adam was 123 feet 9 inches high, and Eve 118 feet 9 inches 9 lines, and that men grew less and less and would have now been microscopic but for a merciful interposition.

Mortality, after from the 11th to the 16th year, according to the country,—after the 14th as the average,—the year of its minimum since birth (*suprà*, p. 1002.), increases rapidly, from the 15th to the 17th, so that the amount of persons among whom is one death diminishes by at least one whole number annually. After the 17th year, the increase of mortality is not so great. For, in the 56 years after the 14th—that is up to the 70th, the amount of persons among whom one dies lessens 2·39 annually: while in the subsequent 40 years up to 110, it lessens but 0·31 annually. During the first 14 of the 56 years, the diminution of mortality is such that the number of persons among whom one dies increases annually by almost 10·25: but, in the first 6 of these 14 years, the diminution is not so great as in the next 8; being, on the average, an increase of only 8·81 in the number of those among whom one dies annually in the first 6 years, and in the next 8 years 12·88. Thus life proceeds most rapidly, changes its proportions most suddenly, and is the most subject to fluctuations, before puberty; continues in a kind of mean state during the procreative period and the beginning of old age; and proceeds the most slowly, with the smallest changes and fewest fluctuations, in old age.

The climacteric diseases, as they are called, have no influence: for the period of the first teething is less fatal than those preceding it. During the second teething,—in the 7th and 8th year, the mortality lessens considerably. At the period of puberty, that is the period dating from the 15th year, the mortality indeed increases, but it still is very much less than at the 20th and from that to the 30th year. At the period of the cessation of the sexual functions there is no greater increase of mortality than in the preceding years, nor is the mortality greater than in the following years.[h]

From some fancies about numbers adopted from the Chaldeans by Pythagoras and spread by his authority in Greece, certain years of life were thought less healthy than others and termed climacteric. They were chiefly those to which the number seven applied, multiplied by an odd number; and that which was seven multiplied by the highest odd number,—nine, was considered the grand climacteric—63. It is clear, however, that no reliance can be placed upon such assertions. In the first place, persons differ as to the year of their constitutional changes of puberty, cessation of menstruation, and all others, not only one but more years. In the next place a private practice is almost too limited for observations of this kind; and absolutely insufficient unless accurate statistical accounts of every patient in that practice are kept. I am not aware that those who have written in favour of climacteric years of decline have ever thought of taking such pains. Burdach, however, has brought the matter to the test of extensive statistical tables, including the mortality of every year of life up to 109; and they show not the faintest trace of a climacteric year. But it is worthy of remark that there is a greater healthiness in the even years, and a greater mortality in the odd. It is thought that the odd days of a disease are those in which an aggravation of the symptoms and either favourable change or or death,—the crisis, take place the most frequently, both in men and brutes.

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[h] Burdach, § 628.

Mortality is less among females than males, whether the latter labour or pass useless lives, as in most monasteries, after puberty as well as before, to extreme old age; and pregnancy, parturition, suckling, and the cessation of the catamenia, have no influence on their mortality.

The statements made with respect to the relative mortality of different ages will probably hold good under all circumstances; but the absolute mortality of them must depend upon the circumstances in which persons are placed. Malaria or vegetable or rather phyto-septic miasma is the greatest scourge of the earth, and accordingly, when it is naturally the most abundant and when art has done the least to control it, there is enormous mortality. The average life of all ranks in the peninsula of India falls one eighth below what it is in Europe[i]; and the 60th year is seldom attained there.[k]

In the British islands are the greatest means of health, and accordingly in a million of persons 18,200 die here annually; whereas in European Turkey, 33,000; in Greece and Italy, 33,300; in the Low Countries, 26,500; in France, 25,600; in Prussia, Austria, Switzerland, Portugal, Spain, 25,000; in Denmark, Poland, Germany, Flanders, European Russia, 22,000 and some odd hundreds; in Sweden and Norway, 21,300.

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[i] Dr. J. Johnson, *On the Influence of Tropical Climates.*

[k] *Oriental Field Sports,* vol.i. p. 236.

The accumulation of human effluvia in the air also shortens life. In the first Annual Report of the Registrar General, lately published, Mr. Farr shows how much greater the mortality of the great towns of England is than that of the counties. In London and 24 other towns the population was 3,553,000; and he took rural districts containing a population of 3,500,000 for comparison. The deaths in the towns during 6 months amounted to 47,953; in the rural districts to 29,693.[1] Among 1000 deaths above the age of 70 in England and Wales, 99 occurred in London, 78 in Birmingham, 68 in Leeds, 60 in Liverpool, only 53 in Manchester: but 202 in Durham, 208 in Devonshire, and 210 in North Lancanshire, Westmoreland, Cumberland, and Northumberland. Our country is well drained; but the poor districts of our towns are close and filthy. The influence of poverty is shown by the fact, that in London, where the greatest number of people are crowded together, but where poverty is not so great as among the wretched weavers at Manchester, and the poor of other places, not only the number of persons who live to be 70 is nearly double that of Manchester, but the mortality among infants less than the average of all England and Wales.

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[1] The following is the table of the causes of death: —

Epidemic, endemic, and contagious diseases	12,766	6,045
Sporadic Diseases.		
Of the nervous system	7,705	3,607
— respiratory organs	12,619	7,847
— organs of circulation	590	309
— digestive organs	3,476	1,832
— urinary organs	219	161
— organs of generation	460	265
— organs of locomotion	262	154
— integumentary system	62	55
Of uncertain seat	4,396	3,730
Age	2,924	3,102
Violent deaths	1,370	929
Not specified	1,104	1,657
Total	47,953	29,693

Better draining, ventilation, public, domestic, and personal cleanliness, will effect a great reduction of this mortality, both by preventing diseases and by lessening their intensity and rendering the restorative powers of the body and of art the more efficient in remedying them. Improvements will gradually lessen the unhealthiness of many occupations; and advances in mechanical contrivance will lessen the necessity for so much human labour. More wholesome and abundant food will be supplied. The total abstinence from alcoholic drinks and other narcotic substitutes will greatly augment health and lengthen life. Plenty of wholesome food and fresh air are the best strengtheners, and rest when we are fatigued is the best restorer. When, in addition, a rational view of happiness prevails, so that men see the folly of wearing themselves out and subjecting themselves to incessant annoyance for worldly distinction and display or the possession of useless riches, but prefer plain competency with time for the pursuit of truth and refinement, benevolence, and healthy recreation[m], life will be far less shortened and will be a blessing, rather than what it too often is,—a curse, though in spite of themselves most men instinctively cling to it.[n]

Few attain the senile εὐθανασία — death without disease. The greater part, we have seen, perish long before, and those who are nearly exhausted by old age generally perish of some disease a little before their time.

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[m] The great advantage of a temperate and sedate life, with cleanliness, and abstinence from laborious and unhealthy occupations, is shown by the superior value of life among Quakers. This is so much above the value of other lives that they have Assurance Societies for themselves. While among infants under 5 years of age, 1 in $2\frac{3}{4}$ die among others, only 1 in $4\frac{1}{2}$ dies among the Quakers; between 5 and 10 years of age, 1 dies in $15\frac{1}{2}$ among others, but only 1 in $22\frac{1}{4}$ among the Quakers; and so on till 70 and upwards, when the mortality is equal. (Chambers's *Edinburgh Journal*, No. 302.)

[n] The mortality has long been diminishing in most of the countries and towns of Europe, and has been greatly reduced in every establishment in which ventilation, &c. &c. have been improved. See *Edinburgh New Philos. Journ.* April, 1834. Also Dr. A. Combe's excellent *Treatise on the Physiological and Moral Management of Infancy.* 1840. ch. 2.; and Dr. John Wilson's *Statistical Reports on the Health of Seamen and Marines for from* 1830 *to* 1836, printed by order of the House of Commons, 1840.

To the disgrace of human nature be it known that, while the whole mortality at New York and Philadelphia is 1 in from 33 to 39, the mortality among the slaves is 1 in 18: and that, while at Baltimore the whole mortality is 1 in 44, the mortality among the free negroes is 1 in 36, and among the slave negroes, 1 in 6.

The cessation of life may be without suffering or agony. It may be instantaneous without any warning, or instantaneous but with warning; it may occur as merely an increasing weakness, and be felt as a gentle sinking into sleep; though the previous condition be one of suffering, the brain often at last becomes comatose, and death strikes without the patient's knowledge; in other cases the brain remains intelligent, and death is slow and difficult. Here we have the agony of death: horrid dyspnœa; gasping; dreadful faintness; sweating; lividity of the face; and restlessness and convulsions; and life does not cease till the unhappy being is suffocated by the want of purification of the blood in the lungs. There may be a calm, and the excitement again appear. Intelligence too, after suspension, may return, and repeatedly, before it is extinct for ever.

An earthy cadaverous smell, something like that of mouldering bones, is sometimes very perceptible in disease before death. It may exist for several days, and I think I have known it recovered from.[o] That the emanations undergo a change not hitherto recognised is certain from a fact, which I have ascertained in the case of Elizabeth Okey, who has no sense of smell, viz. that a very unusual idiosyncrasy is possible, through which emanations from persons in a dangerous condition of health produce the most oppressive and distressing feelings; and, should the individual endowed with the idiosyncrasy be at the time in a morbid condition of mind, may cause a delirious phantom to be imagined. This idiosyncrasy is thus a test of what could otherwise not be appreciated: just as the idiosyncrasy of hay catarrh or asthma is a test without which we should not know a peculiar property of the emanations from the flower of grass.

As the powers decline, when death is not instantaneous, the individual lies upon his back and slips down more and more; speaks more faintly and with pauses; the mucus rattles from time to time in the throat at expiration[p], as the patient cannot remove it. Occasionally the countenance is that of a corpse for hours before death; or longer.

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[o] See also Garmann, *De Præsagio Mortis ab Odore. Ephem. Nat. Cur.* dec. 1. ann. 1670. obs. 144.

[p] In cases of prostration of strength the mucous tracheal rattle of expiration is rarely recovered from when once it has begun: that of inspiration is not a fatal sign.

The extremities, nose and ears, and the breath, grow cold; the eyes lose their brilliancy, and are partly turned upwards and inwards, and half covered by the lid; the face becomes pale and pinched and the eyes hollow; the voice falters; the pulse grows smaller and smaller, then slower, at length it intermits, and this more and more, and longer; every expiration rattles; and the breathing grows slower and intermits, and its intermissions become more frequent and long, till at last it ends for ever in one expiration; the pulse ceases in arteries[q] nearer and nearer to the heart, and the heart generally gives at least one beat after the last expiration, and is felt no more.

The varieties in the bodily condition of dying persons depend entirely upon the part which dies first and its rapidity in dying.[r] If the heart suddenly stops, death is instantaneous, the brain becomes unconscious, and respiration stops; if the portion of the encephalo-spinal organ upon which respiration depends is suddenly compressed by blood or stupefied in any other way, or if its communication with parts below is severed, death is instantaneous; if the lungs are suddenly prevented in a direct manner from continuing their functions, the encephalo-spinal organ is presently stupefied and the heart very soon ceases to act. When death does not begin by the heart, the action of this usually continues at least one beat after respiration.[s] But when the power of the encephalo-spinal organ over the thorax is lost slowly; or the lungs are slowly, by effusion, &c., prevented from continuing their function, we have a slow and agonising death. With this exception, and that of pain or distressing disease existing in any part at the time of death, or of an unhappy condition of the mind, death is by no means distressing; and all that the person requires is to be let alone and allowed, as if sleepy, to die in peace. When, however, persons appear insensible, it is certain that frequently they are cognisant of their existence and of what is passing: for I have known them requested to give a sign that they were still alive by moving a finger, or by interrupting their breath when to move a finger was impossible; and they have done so, although believed by many to have been long senseless. There may, therefore, be suffering when we might not suspect it.

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[q] Under the microscope the quantity of blood is seen to grow smaller and smaller in the arteries, till the minutest contain none, and the capillaries very little; and at last it is at rest in the arteries though it still oscillates for a time in the veins. Dr. Kaltenbrunner has observed more blood to remain in the capillaries of the viscera than of the surface. The lungs, having a contractile power of their own, withdraw themselves from the thoracic walls after death, by which a space is left, and this occasions the blood to flow abundantly towards the lungs: so that Dr. Carson found, if air was let into the pleuræ at death, that the capillaries contained so much the more blood and the arteries also were turgid. (See *suprà*, p. 212.)

[r] Upon the differences of the commencement of death, see Bichat's *Recherches Physiologiques sur la Vie et sur la Mort.*

[s] In brutes, the right side of the heart is seen to beat longer than the left; for the right must, while the left beats, have from this circumstance, and afterwards for some moments from the contraction of the systemic arteries and capillaries, a supply of blood to stimulate it and will beat: but the cessation of respiration

As the sun shines upon the just and the unjust, and health and strength and domestic happiness and worldly prosperity and honours are given to the wicked and to the undeserving as well as to the deserving, so the corporeal agony of death is just as often the lot of the good as of the bad. In regard to the bad, who have caused misery to others, I confess myself astonished to see the calmness and happiness with which they often meet their fate: and it is absolutely shocking to see the effects sometimes produced upon the most atrocious felons by priests, who console them up to such a pitch that the guilty wretches, who have plunged whole families into misery and would probably do the same again if liberated, not only die very happy, but are anxious for the hour of execution to arrive that they may enter into the presence and joy of the Creator of the universe, convoyed by a flock of angels, and pass their existence to all eternity with him and the spirits of the blessed; and actually thank God for having committed their crimes since these have turned out so good a thing for them.

If the natural character is very strong, the state of mind at the approach of death will depend upon it. Lord Bacon has collected examples of remarkable conduct at death. Some have died jesting; some uttering imprecations; some cheating; some lying; some acting the hypocrite; some quietly resigning themselves

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will arrest the blood in the lungs and prevent a supply to the left side of the heart, which therefore will stop though the right ventricle contract.

to nothingness, some to a future state, some to uncertainty. The greater part die thinking and acting according to the influence exerted upon them by education and example in their previous life and by those about them at the close.

The desire to live is in some so intense that they are miserable at the close of life; and some have actually thrown themselves out of bed in distraction, resolved not to die, and exclaiming, "I will not die." But for the most part very old people, whether their lives have been good or bad, are resigned: think they have lived long enough, and look forward, perhaps impatiently, to their end. Many are well aware of their approaching end[t]; and some (even children) calculate the day and hour of its occurrence to a nicety:

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[t] Cavendish, the discoverer of the composition of water, lived alone at Clapham, where my family also resided; and, when he felt his end very near, desired his valet to leave the room and return in a certain time. The man, on his return at the time ordered, found him dead. Dr. Cullen, when dying, faintly articulated to one of his friends, "I wish I had the power of writing or speaking, for then I would describe to you how pleasant a thing it is to die." Sometimes the faculties of the insane or fatuitous return just before death; sometimes the intellect of the sane is greatly heightened, sometimes the superior moral feelings. Consult on this point, Osiander, *über die Entwickelungskreiten*, t. i. p. 123. The occasional brightening of the mind before death till it could almost prophesy has been noticed from the most ancient times. Homer represents the dying Patroclus foretelling the fate of Hector, and the dying Hector denouncing no less certainly the death of Achilles. (*Iliad*, xvi. 852., xxii. 358.) Shakspeare makes Hotspur (*Henry IV.* Pt. i. Act v. sc. 4.) say,

"O, I could prophesy,
But that the earthy and cold hand of death
Lies on my tongue:"

and the dying John of Gaunt (*Richard II.* Act ii. sc. 1.) exclaim,

"Methinks, I am a prophet new inspir'd,
And thus, expiring, do foretell of him."

Socrates, who, though so good and great, was clearly a monomaniac, (see Dr. Lélut's *Démon de Socrate.* Paris, 1836.) when near his death, fancied he could prophesy.

He (Plato, ΑΠΟΛΟΓΙΑ) and other ancients and moderns have fallen into the error of mistaking the close of nature, which they knew produced occasionally an increase of penetration and elevation of the moral sentiments for the proximity of death under all circumstances, even by violence or accident while persons are in health. For references to authors on this subject, see Bishop Newton's *Dissertations on the Prophecies*, vol. i. diss. iv.

whether from an inward feeling through idiosyncrasy, which I believe occasionally to exist; or from the impression of the mind influencing the period of the event.

Long before the system is worn out by age, any part may die. If the part is not necessary to life, or the portion which dies is small, it may be separated by the absorption of the living part around, and the system continue to live in health as before. Even small portions of the lungs have thus died and been separated, and the patient has recovered.

In regard to premature death, the defect of air, food, warmth; defect of repose; slow excessive loss of matter from the system: continued over excitement of any one organ or of the whole system; sudden excess of stimulants; sudden loss of a quantity of the fluids, which if slow would be borne; the sudden withdrawal of pressure from important parts: derangement of condition from the influence of noxious agencies: continued excess of food, or temperature: unhappy states, continued or sudden, of the cerebral feelings, nay a sudden excess of happiness,— will all destroy the conditions which are indispensable to life. The functions of the encephalo-spinal system may be impaired to the point of not inspiring, or the heart may become unable to beat, and so general death be occasioned ultimately by these organs, though they may be suffering only in common with the whole system;—all parts equally suffering, and the vitality of all being equally impaired. A part unimportant to life, as a finger or a limb, may be entirely lost without disturbance to the system; and yet a diseased condition of it, or a sudden mechanical shock to it if it be a limb, may derange the system even to loss of life.

Death does not take place in all parts at once. The intellectual and moral feelings of the brain, even the power of swallowing, may cease, and yet life still exist. Respiration may have ceased, and the heart may beat for a short time. The heart may have ceased to beat, and yet the motion of the fluids continue in the minute vessels. Dr. Speranza mentions a young man who had died at 20 years of age of encephalitis, whose face continued warm, and his body covered with drops of sweat, which were renewed, if wiped off, for three hours; and at the end of 24 hours, though the body was livid, there was still sweat. Richerand also mentions such a fact. The temperature, if it has fallen from the death having been sudden, may rise again for a time, as though the minute vessels had a little recovered themselves.[u] The uterus has been felt to contract strongly a quarter of an hour after death in labour.[x] The hairs and nails have been known to grow after death. Absorption also may continue for some hours. Dr. Magendie found the lacteals fill again, after being emptied by pressure, two hours after death. Voluntary muscles will obey mechanical irritation for a time; and galvanism will produce contractions. The contraction of the arteries after death was mentioned *suprà*, p. 185. The intestines may move for some time after life has ceased.[y]

After death the body becomes cold. But the rapidity of its cooling depends upon the surrounding temperature, and the quantity of fluid in it: for, if there is much blood or even dropsical fluids, the period is much lengthened. The drier the body, the sooner does it cool. — The countenance while the corpse is fresh has generally a heavenly serenity.[z] Sometimes the features are much changed for a short time after death, and subsequently assume their usual appearance.

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[u] Bush declares that a blow after death has caused it to rise temporarily in a rabbit and dog. (*Experimenta quædam de Morte.*)

[x] *Dict. des Sc. Méd.* t. xix. p. 338. *Gemeinsame Zeitschrift für Geburtskunde,* iii. 3.

[y] This is seen in slaughtered brutes. Neither the semen nor ovum loses its vital qualities immediately. Spallanzani fecundated all the eggs of toads, eight and even twelve hours after they had been killed; and those of two other dead toads, kept in a glacier to prevent putrefaction till the semen was applied at the end of 24 hours. (*Expér. pour servir à l'Histoire de la Génération,* p. 155. sq. Génève, 1785.) He found the semen of males which had been killed 3 and even 5½ hours still prolific. (*Ib.* p. 147.) Jacobi produced impregnation with the roe of a male carp four days after its death. The semen of toads was as efficient in the hands of Spallanzani six hours after separation from the body and retention in a glass tube stopped with sealing wax, as when fresh furnished; not quite so good at the end of 7 hours; and good for nothing at the end of 9. (l. c. p. 148.) Preserved under a layer of oil or wax, or bottled for use and corked by the philosopher, it lost its virtue as much as in the open air. (p. 384.)

I may here mention a fact showing the independence of the life of parts that might have been thought to exist indissolubly with another. An ovum has continued to grow sometimes after the death of the embryo (Meckel, *Beyträge,* t. i. p. 61.): and has even cicatriced and been discharged containing the usual quantity of liquor amnii at six months after the embryo had escaped from it at three. (Lobstein. Burdach, § 461.)

[z] "He who hath bent him o'er the dead
Ere the first day of death is fled,

Every part shrinks, and becomes more rigid than during life, both from the escape of much moisture from the body, and from a tonic contraction. The contraction observed by Dr. Parry in regard to the arteries (see *suprà*, p. 186.) holds good in regard also to the lymphatics, cellular membrane, and ligaments. The fat, from being very soft during life, has, in losing its temperature, necessarily become solid, and the blood has more or less coagulated. But the rigidity of the whole body, though increased by these circumstances, is independent of them, and is owing chiefly to a rigidity of the muscles which comes on from 10 minutes to 7 hours after death[a], and usually lasts several days. This commonly begins in the muscles of the lower jaw and nape of the neck, and almost at the same time in the trunk, and proceeds first to the upper and then to the lower extremities: and it declines in the same order. It begins later, is weaker, and of shorter duration, in children than in adults; and this in proportion as they are younger, so that a fœtus of 7 months does not exhibit the phenomena. The greater the strength of the person at the time of death, the more marked it is. The muscles are no longer excitable by stimuli; and become denser and firmer than before, so that a

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Before decay's effacing fingers
Have swept those lines where beauty lingers,
And mark'd the mild angelic air,
The rapture of repose that's there,
The fix'd yet tender traits that streak
The languor of the placid cheek,
And, but for that sad shrouded eye
That fires not—wins not—weeps not now,
And but for that chill changeless brow,
Where cold obstruction's apathy
Appals the gazing mourner's heart,
As if to him it could impart
The doom he dreads yet dwells upon,—
Yes, but for these and these alone,
Some moments, aye, one treacherous hour,
He still might doubt the tyrant's power:
So fair, so calm, so softly seal'd,
The fair last look by death reveal'd." (*Giaour.*)

[a] Sommers, *Recherches de Physiologie et de Chimie Pathologiques.*

muscle, which while contractile by stimulus soon after death would tear by a weight of 2 ounces, will 24 hours after death support 2 pounds. This rigidity, if once overcome by force, after it has fully taken place, never returns. I mentioned at page 482., that it depends upon a mere consolidation of the muscles, unfitting them for contraction from any exciting cause. It appears attended by a slight shortening, since the lower jaw ascends a little, the fingers become a little bent, the thumb approaches the root of the little finger, and, if the stiffness is great, the fore-arm is perhaps slightly bent. I have already stated (*Ib.*) that, when death occurs under circumstances which prevent the coagulation of the blood, (see *suprà*, p. 291.) this rigidity of the muscles is said to be equally prevented; and that, therefore, it is probably a chemical change only. When sufficient time has elapsed for the changes of decomposition to begin, it ceases; while it lasts, there is no sign of putrefaction. Burdach asks, in objection, why this rigidity does not take place after asphyxia by various gases, and after death from hæmorrhage, or from frost, nor in embryos at all? The answer is, 1. That when the nature of the causes of death prevents it, they prevent also the coagulation of the blood. Now, if the coagulation is a chemical change, as I contended at page 152., we may presume that this muscular rigidity or condensation is a chemical change. 2. The more soft and weak the muscles, whether from early age or the exhausted state of the body before death, in which cases this phenomenon is less observable, the poorer must be their composition: the greater the vigour of the muscle, in which case the rigidity is more striking, the more perfect must be their composition: and the same is precisely the case with the coagulation of the blood. Burdach classes the rigidity among those phenomena of a tendency to condensation and independence that occur at death, and finishes with the words, "in this respect we may, with Sommers, compare the cadaveric rigidity to the coagulation of the blood." Yet he regards it as "a last manifestation of living muscular force," having some analogy to spasm; in the same line, however, allowing that it occurs when the sensibility of the muscles is extinct, and having previously allowed that "it cannot be the result of simple contractility," "and differs from the continued action of contractility." As this rigidity occurs only when the muscle is no longer susceptible of the influence of stimuli and is dead and will not yield to a weight which would tear it while it was susceptible, there must be a great condensation, and this cannot but be a chemical change.

The corpse is pale at all the superior parts, even though these had been inflamed or congested during life. After a time, all the lower parts to which the blood gravitates grow livid: internally, the blood is found accumulated in the lowest parts.[b] The eyes are open; the mouth, bladder, and rectum are half open from the loss of muscular power: the muscles are all rather soft and easily torn; the penis and breasts hang relaxed. Pressure flattens every part which experiences it, so that the nates, loins, and back are particularly flattened. The fulness of the body subsides: and the eyes, temples, and cheeks are hollow: the cornea is filmy, opake, and flat, and at length flaccid: the nose pointed: and the ears and lips are thin.

The eyes, mouth, nostrils, and all exposed parts, grow dry from evaporation.

From the impediment to the progress of the blood through the lungs being experienced first by the veins, from the force of the heart being always most operative on the arteries, and from the great contractile power possessed by the arteries, little blood is found in these and the left side of the heart, but a large quantity in the veins and the right auricle and ventricle. This longer supply of blood to the right side of the heart is the reason that the right acts longer than the left. (*Suprà*, p. 1043. note [r].) The venous blood of the cavæ and right auricle is usually fluid; that in the left auricle and ventricle and in the arteries usually coagulated.

The blood gradually transudes through the vessels; so that wherever a vein at an inferior or dependent part runs, a broad red band is seen, and it is not well defined, but irregular at its margins from the irregular escape of blood. Transudation also takes place of the bile, and of every other fluid; even of one artificially introduced. The blood grows thicker and darker as time elapses. The humours of the eye become turbid; and the cornea and the serous membranes lose their transparency.[c]

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[b] The posterior part of the lungs in the supine corpse is therefore of a dark red and solid with blood.

[c] Lenhossek says that the natural transparency of the pericardium and peritoneum in a child born with its trunk unclosed, as well as the transparency of the cornea, lessened during life, if syncope or suffocation occurred; and returned with returning animation. (*Medicinische Jahrbucher*, vi. 2. p. 67.)

A truly cadaverous odour is soon perceived, "so that if these *collective marks* are present," says Blumenbach, "there can scarcely be room for the complaint of Pliny that we ought not to feel assured of the fate of a man, though we see him lie dead."[d] But we ought never to treat a person as dead till marks of putrefaction appear, for many have been interred alive; and I am persuaded that many have died because deprived of their previous covering and put into a room without a fire in winter, from the belief that they were dead. The odour should be that of putrefaction, not that merely earthy smell which may be perceptible before death. There should also be visible marks of putrefaction. However late putrefaction may be in commencing, we ought to wait. If a body is dead, and the temperature not extremely low, and no antiseptic measures be adopted, putrefaction sooner or later begins.

When the condition called life ceases, the compounds of vegetables and animals, being ternary and quaternary, are not held firmly together; they yield to the tendency of matter to form binary compounds, and decomposition and fresh composition take place.

The first odour of a dead body is that of fresh meat. This soon yields to a peculiar fœtid smell, which attracts flies to the body and induces them to lay their eggs in what is about to become fit nourishment for their young.

The signs of putrefaction are the putrid smell; a greenish tinge, first visible in the abdomen, and at length a redness and almost blackness of the surface; a swelling of the abdomen and at length of the whole body from the disengagement of gases and the liquefaction of the solids; a general softening, and at length a pulpiness; the issue of frothy fœtid red fluid from the nose and mouth; and at length of fluid from all parts of the softened body.

The smell becomes so intense as to extend to a great distance, and to remain long in the clothes of those who are exposed to it and in the hands of those who touch the body. The more porous and flocculent substances, as in the case of infectious effluvia, are those which retain it longest.

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[d] "C. Himly, *Commentatio* (which gained the Royal Prize) *Mortis, Historiam, Causas, et Signa, sistens.* Gotting. 1794. 4to.

Sil. Anschel, *Thanatologia, s. in Mortis Naturam, Causas, Species, Genera, et Diagnosin Disquisitiones.* Gotting. 1795. 8vo."

The gases are afforded at first by the fluids, and most abundantly by the blood; as the body liquefies, the fresh fluid of course affords it in still greater abundance. The chief products are water, ammonia, carbonic acid, sulphuretted, phosphuretted, and carburetted hydrogen gases: nitrogen is exhaled copiously, also in a pure state.

The parts in which the cellular membrane is the most loose swell, after the abdomen, the earliest; as the eyelids and pudendum: the gases are found not only in all canals and cavities, but even in the substance of the viscera; so that the whole body becomes lighter and swims in water, though up to this time it had sunk; and even individual organs, as the liver and heart, will float. The fluids are driven onwards by the gases, especially the blood, so that congestions of blood take place in the head, heart, liver, genitals; and, if the canal or cavity is open, as the respiratory, alimentary, urinary, and genital passages, their contents are forced out. The production of gases may proceed so copiously that noise perhaps attends its escape, and the motion may be such in the blood-vessels that these perhaps pulsate from time to time. The congestion thus produced, and the redness of membranes and other parts from the softened condition allowing the blood and the fluid resulting from the softening and liquefaction of the solids to pervade them, resemble the states seen immediately after death from congestion and inflammatory disease so perfectly, that no inference of the existence of such previous diseases can be drawn from such appearances, if the temperature is high and any great time has elapsed subsequently to death.[e]

The blood at the same time grows very dark; and every organ loses its natural hue, and becomes dirty looking or yellow or green, or more or less dark than before: then red and ultimately very dark.

The whole mass of solids liquefies more and more, and fluid runs out copiously through openings which take place in all situations. Various insects, at first dipterous and at length coleopterous, swarm upon the body and devour it, as long as it is moist.

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[e] Dr. John Davy's paper on this point is very important. *Med. Chir. Trans.* vol. x.

Great evaporation goes on, and nothing but the bones, with the dried and greatly reduced soft solids,—skin, muscles, fat, and viscera, adhering to them and in a manner carbonised, after a time remains. Apertures and channels made by insects are seen in the body: and, when there is no more nourishment for insects, vegetable parasites take their place, champignons at first, and subsequently lichens, flourishing upon it. At length the dark coloured, light mass grows friable and falls to pieces; nothing but earthy salts and carbon are found; and ultimately

> "—not a pinch of dust remains of Cheops."[f]

Churchyards, therefore, ultimately have scarcely a sensible augmentation of their soil.

Bodies, like vegetable matter in the fire when reduced to a mere cinder, sometimes retain their form, but crumble to powder on the least touch. This was the case with the body of Alexander the Great when his tomb was opened before Augustus.

Some parts putrefy sooner than others. The brain softens immediately, and exposure to the air occasions it to soften rapidly while we are examining it. The softer and moister the solids, *cæteris paribus*, the sooner do they putrefy.[g]

These changes take place in various times, and with various modifications, under different circumstances.

The weaker the system, or any portion of it, before death, the more rapid are they. After putrid diseases, and diseases in which the natural composition is impaired, as after that condition which is in some measure analogous to putrescency, — softening — a state sometimes local sometimes general, scurvy, and death by some poisons, putrefaction advances very rapidly. The fœtor of a body softened before death clings very strongly to the clothes and hands of others. When a part has been exhausted by inflammation and has much congestion in it, the decomposition is rapid. The more juicy the body, the greater is the rapidity. A warm temperature, especially one from 60° to 90°, and plenty of air, at least of oxygen, greatly promote putrefaction; and the absence of moisture, air, and a certain temperature, absolutely prevent decomposition. Strong electric shocks are said to make dead flesh putrefy the more quickly.

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[f] Don Juan, I. 219.

[g] Phosphorescence occasionally precedes the fœtid state of putrefaction; probably from the abundant disengagement of phosphorus in some form or other, and perhaps sometimes from the production of phosphorescent animalcules. Fish just beginning to putrefy exhibit phosphorescence oftenest and most strikingly. The body of a herring will emit light, a day or two after death, before putrefaction has decidedly commenced. Fabricius ab Aquapendente tells of three Roman youths at Padua, who in 1562 bought a lamb, and what they could not eat on Easter Sunday shone on the Monday in the dark like so many candles. Some kid's flesh in contact with it and the fingers and other parts of the bodies of persons who touched it also became luminous. Bartholin mentions a woman at Montpellier, in 1641, who bought a piece of meat and put it in her bed-room, when in the night it illuminated the place with a whitish light, which was emitted from spots as though gems of unequal splendor were scattered over it. When the meat began to putrefy, the light vanished, and as some religious people fancied, "in the form of a cross." Dr. Graves states that the subjects in his dissecting room were for one or two nights covered all over with a phospho-

If moisture is withdrawn, by placing the body in a powdery medium, putrefaction is impeded and a dried mummy of not more than a few pounds in weight is produced. Such mummies are found in the sand of Egypt and Arabia, and occasionally in English vaults. I have seen them from St. Saviour's and St. Bride's in London. If all moisture is rapidly abstracted, no putrefaction can occur. Gay-Lussac preserved meat fresh for many months by placing it under a receiver with chloride of calcium. He found no decomposition possible while air was excluded: and, on the other hand, putrefaction proceeds more rapidly in oxygen, and the more a body is reduced to pieces and thus brought into more extensive contact with the air. Consequently decomposition proceeds much more slowly under ground than in the open air; and bones have been found in stone coffins where they must have lain above a thousand years. The soft parts of bodies interred a few feet disappear in about six years, and the greater part of the bones in twelve.

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rescent effulgence, and that in his nocturnal "resurrectionary expeditions" to graves he was frequently struck with the luminous appearance of old coffin boards. (*London Med. and Surg. Journ.* No. 153.) Freezing arrests it; but thawing restores it. A boiling heat puts an end to it for ever. Exsiccation stops it. A vacuum, carbonic acid gas, hydrogen, sulphuretted hydrogen, and nitrous gas, strong acids, alcalies, alcohol, ether, arrest it: but the fresh air in the first five cases, and dilution in the last, restores it. The wood of dead vegetables frequently exhibits phosphorescence at a medium temperature; as well as potatoes, the root of valerian and tormentilla, and various putrefying mushrooms. See Tiedemann's *Physiology*, cccc. sq.

In northern regions the carcases of animals lie unchanged upon the snow. The mammoths found in perpetual frost have withstood all decomposition for many thousands of years.

A high temperature equally prevents it; for dead bodies on burning deserts remain unchanged. Both extremes are partly alike; the one dissipates, the other congeals, the moisture which is indispensable to putrefaction. A temporary very high temperature, without dissipating moisture, so changes the proximate principles that decay is retarded. Meat that would spoil is kept sweet by cooking: after a time, however, decomposition takes place, unless it is completely protected from the air. Meat heated to 212°, and, without the least subsequent exposure, kept from the air, may be preserved for years, even in moisture and a temperature favourable to putrefaction.

Certain substances forming by their chemical action with the animal matter new compounds which, not being ternary and quaternary compounds, are not liable to putrefactive decomposition, will preserve animal matter from decomposition for a longer or shorter time. The new compound, however, will at last rot. Common salt, nitrate of potass, creosote, alum, sugar, acids, alcohol, &c., have strong antiseptic powers.

I have had a coagulum of blood dry, solid, and perfectly sweet, now for six years, which I originally soaked in creosote; and a saturated solution of alum injected into the right carotid is employed to preserve human bodies sweet for dissection and recognition. The process of embalming consists in removing the more easily putrefying of the viscera, introducing bituminous and aromatic substances, and excluding the air. Egyptian bodies have thus been preserved above three thousand years.

The acid and fatty substances putrefy less rapidly than urea, fibrin, and analogous principles. If animal matter is kept under water, the fibrinous, albuminous, and gelatinous parts, which have any stearine or elaine among them, become changed to a fatty or soapy substance called adipocire. While the oxygen of the water is absorbed, its hydrogen unites with the nitrogen of the animal matter, and the ammonia produced, not being carried away, unites with margaric acid which is generated in the absorption of oxygen by the elaine or stearine, into a sort of white soap — adipocire.

When vegetable substances, fluids or soft solids, decompose, they grow warm and agitated, — ferment: alcohol is first produced, — the fermentation is first vinous: then acetic acid is produced,—the acetous fermentation occurs; and ultimately they putrefy. Vegetable substances are composed chiefly of oxygen and a larger proportion of carbon and hydrogen. In the vinous fermentation, the proportion of these elements which constitutes their sugar is disturbed: some of the carbon and more of the oxygen escape in the form of carbonic acid gas, and the predominance of hydrogen with the reduced carbon and still more reduced oxygen produces alcohol. Changes constantly go on in this vinous fluid,—a compound of alcohol, mucus, water and odorous and sapid substances; so that every year a wine has fresh sensible qualities. These changes at length are no improvement, but a deterioration: and at length the carbon lessens, and the hydrogen still more; so that the oxygen predominates and acetic acid is produced. Some vegetable substances, as gum, starch, and extract, turn sour at once without becoming alcoholic. Putrefaction requires the presence of oxygen and hydrogen in the proportion that forms water, and likewise of nitrogen; and, as plants are so destitute of the latter, their gluten and starch only putrefy. Nor will all parts which contain nitrogen putrefy with the same readiness; those probably whose texture is the looses undergo the change with the greatest facility.

Those in which charcoal and hydrogen prevail, as the oils, resins, and alcohol, do not putrefy.

Dr. Caspar calculates that there are 960,000,000 human beings on the earth[h]; and that the average deaths are 29,000,000 an-

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[h] On a calculation about 12 years ago that there were upwards of eight hundred millions of human beings, they were classed, according to their profession of belief, or that of the majority of their nation, as,

A. Monotheists.		
1. Jews	7,000,000	
2. Christians	232,000,000	
3. Mahometans	122,120,000	
4. Disciples of Zoroaster and Confucius, Nanclists	10,380,000	
		371,500,000
B. Polytheists.		
1. Bramins	120,000,000	
2. Buddhists	240,000,000	
3. Fetich worshippers	128,000,000	
		488,000,000

nually, 80,000 daily, nearly 3,300 hourly, and 53 every minute. It is thought that 25 boys and 26 girls,—51 children, are born every minute.

In general, in our latitudes, more persons die at the end of winter or beginning of spring and fewer at the end of summer or beginning of autumn than at other periods: and more die in winter than in summer. The same holds in regard to even still-born children. In general the month of the greatest mortality is February, and the month of the least is August,—the one often the coldest, and the other often the warmest, month. The more extreme the cold in spring, and the heat in autumn, the greater the mortality; and *vice versâ*. A very cold winter is exceedingly fatal.[i]

The youngest individuals die mostly in January; those from 2 to 3 years of age, mostly in March; those from 8 to 12 years of age, mostly in April; and those from 12 to 16 years of age, mostly in May. The fatal effects of cold are thus more rapid in those whose energy is the least. After 16 years of age, the vital energy would seem to resist the inclemency of season less and less: among persons from 16 to 20 years of age, the greatest mortality is in April; among those from 20 to 25, in March; among those from 25 to 30, in February; and among those above 40, in January. The smallest mortality occurs in Belgium among the youngest in July; among those from 2 to 8 years of age, in August; and among those from 8 to 20 years of age, in October; and among the older, in July. Hence Moser infers that even healthy influences produce their good sooner in the younger than those who are more grown; and that the proper inference is not that evil influences, but all external influences, act sooner accordingly as the vital energy is less.[k]

The season of greatest mortality must depend upon local circumstances as well as upon the general laws of the seasons.

The greater number, or nearly so, of deaths occur after midnight at the first of the morning,—the time of the greatest number of births and of attacks of asthma, gout, &c.

Gruithesen declares that some infusoria have, from the first, their permanent shape and dimensions; and Nitsch that among the cercaria all the individuals of one generation are of the same size, without ever growing or propagating. (*Beiträge zur Physiognosie*, p. 303.)

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[i] Dr. W. Heberden.

[k] Burdach, § 619.

A fungus (Bovista giganteum) acquires the size of a gourd in a single night. It has 47,000,000,000 cells, each equal to $\frac{1}{200}$th of an inch in diameter; so that 4,000,000,000 cells must have been developed every hour, or above 66,000,000 every minute. (Dr. Lindley's *Introduction to Botany*, p. 7.)

Plants were observed by M. Meyer, superintendent of the Botanical Garden at Königsberg, to grow twice as much in the day as in the night.

Some brutes undergo extraordinary metamorphoses after birth. An insect is, on first leaving its egg-shell, a maggot (*larva*); then it becomes a grub (*nympha* or *pupa*, &c.); and lastly a fly (*imago*). The frog is at first a tadpole, has no extremities, but, like a fish, tail and gills. Dr. Edwards has proved that, by excluding tadpoles from the light, they will grow to double or treble the size that tadpoles usually attain, but are not metamorphosed to frogs. He thinks that the proteus anguinus, which, like tadpoles, has lungs and gills, is but the first stage of an animal which is prevented from becoming perfect by inhabiting the subterraneous waters of Carniola. The larvæ of tritons always eat up each other's transitory organs, — tails and branchiæ: and almost always the smallest and youngest among them; so that, although one will live solitarily for three months, it is never developed without companions. The larvæ of frogs and toads, after having eaten their external case (*suprà*, p. 842.), and of some insects, often turn cannibals in the same cowardly manner. (Goeze. Rusconi. Burdach, § 460.)

The influence of food upon the changes of animals is great. Aphidivorous flies are larvæ for eight or ten days, pupæ for about a fortnight, and perfect insects about nearly as long; in the whole not living more than six weeks. But a pupa deprived of food underwent no change, and lived a pupa for twelve months. (Kirby and Spence, vol. i. p. 404.)

The infusory animal called *cercaria ephemera* lives scarcely beyond 6 hours, being born at noon and perishing before sunrise. The elephant will live between 1 and 2 centuries; and the whale 3 or 4 centuries: so small a creature as a parrot is said to live best part of a century; and such small fish as carp a century, and the pike between 2 and 3 centuries.

Some champignons live a day or a few days only. Decandolle considers, from the examination of the tree, and from tradition, that an ash may live 335 years, a cypress 350, a cheirostemom 400, an ivy 450, a maple 500, a larch 576, a chestnut 630, an olive tree 700, a plane 720, a cedar 800, a linden 1100, an oak 1500, a yew 2000, the baobab of Africa 5000, and a Virginian cypress 6000. (*Physiologie Vegetale*, t. iii. p. 1007.)

The masses of inanimate matter are larger than than the animate; and, excepting some colossal creatures, vegetables, generally, than animals. Most trees are of great size, and are far more voluminous than any animal. The cocoanut palm grows to the height of 80 feet, living a century, and producing the greater part of its time at least a hundred cocoa-nuts annually. The fruit of the Banana or plantain is often a foot in circumference, and 7 or 8 inches in length; and is produced in branches usually containing from 170 to 180 fruit, and each branch weighing from 66 to 88 lbs. avoirdupois. Animals may be of microscopic minuteness, and few vegetables are so small as many of them. Ehrenberg has discovered the fossil remains of infusoria. They form extensive strata of polishing slate in Bohemia. Each is about the three or four hundredth part of an inch. A cubic line contains about 23,000,000; a cubic inch about 41,000,000,000. There are 187,000,000 in a grain of the slate; or the siliceous coat of one animalcule is the 187,000,000th of a grain. It is to be remembered too that Ehrenberg (*Organisation Systematik und Geographisches Verhæltniss der Infusions thierchen.* Berlin, 1840.) has proved animalcules to have a complicated organisation. But size is only relative, and we may conceive such animalcules possible of a size a million times smaller, or even the whole earth, with all the things it has upon it in their present relative proportion, not exceeding in its size one of these animalcules.

Before birds and mammals existed, fish and reptiles were of more numerous species than at present, and generally of enormous size. The hylæosaurus measured 30 feet; the iguanodon and the megalosaurus from 70 to 80. Among quadrupeds, the megatherium of Paraguay and the mastodon of the Ohio and the Irowadi, were immense. The plesiosaurus was something of both a fish and a crocodile; and the pterodactyle, something of fish, reptile, bird, and quadruped.

CHAP. XXXVII.

DIVERSITIES OF MANKIND.

According to the growth of each part and of the various portions of each part, we have the infinite differences of bulk, form, and proportion that characterise each of us: and according to more minute discrepancies of change are our infinite varieties of texture, composition, and properties: so that it is barely possible for two beings ever to have been perfectly alike, even when at their full growth, in appearance, anatomical structure, chemical composition, or vital properties —

> —— facies non omnibus una,
> Nec diversa tamen.

Animals or vegetables are of the same *species* if they have sprung from the same originals, or resemble each other as much as those which are descended from the same originals, or, resembling each other less than this but far more than others, propagate as readily in perpetuity together. There are 56,000 species of plants known, — about half the number probably in existence, according to Decandolle: and 51,700 of animals.

Animals or plants which agree together as far as this, and yet differ decidedly, constitute a *variety* of their species: and, when an individual of a variety has a difference from others of his variety of an unusual kind, this is a *peculiarity*. The differences of variety and the peculiarities may be of extremely various intensity. The infinite diversities which occur daily, proportioned to each other infinitely in different individuals, require no description; for perfect similarity would strike us as almost a miracle, and the strong mutual resemblance of two individuals always calls forth expressions of surprise.

According to the general composition of individuals, whatever their variety or peculiarity, as shown in their native sensible qualities of hue of skin and hair, firmness or laxity of flesh, &c. &c., susceptibility of excitement, &c., the ancients divided the qualities of frame into *temperaments*.[a]

" So various are the differences of degree and combination in the temperaments[b], that their *divisions* and orders may be multiplied almost without end. We shall content ourselves with the four orders commonly received[c]:—The *sanguineous*,—excited most readily, but slightly: The *choleric*,—excited readily and violently: The *melancholic*,—excited slowly, but more permanently: And the *phlegmatic*,—excited the most slowly of all, and indeed with difficulty.

" This division, although built by Galen upon an absurd foundation derived from an imaginary depravation of the elements of the blood, appears, if made to stand alone, both natural and intelligible."

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[a] " From the endless variety and modification of the conditions belonging to these four principles," (fluids, solids, vital and mental powers) " it may be easily understood what great latitude must be given to the notion of health.

" For, since, as Celsus long ago observed, almost every one has some part weaker than the rest, Galen may in this sense assert with truth that no one enjoys perfect health.*

" And even among those who, in common language, we say are in good health, this is variously modified in each individual. (W. F. Ad. Gerresheim, *De Sanitate cuivis Homini propria.* Lugd. Bat. 1764. 4to.)

" Upon this endless modification is founded the difference of *temperaments;* or, in other words, of the mode and aptitude of the living solid in each individual to be affected by stimuli, especially the mental; and again, of the mental stimuli, to be excited with greater or less facility."

[b] " Lavater, *Physiognomische Fragmente*, t. iv. p. 343.

W. Ant. Ficker, *Comm. de Temperamentis Hominum quatenus ex Fabrica et Structura Corporis pendent.* Gotting. 1791. 4to.

J. N. Hallé, *Mém. de la Soc. Médicale d'Emulat.* t. iii. p. 342.

To the numerous arguments by which the moderns have overthrown the doctrine of the ancients, and proved that the temperament depends on the living solids rather than on the nature of the blood, I may add the celebrated example of the Hungarian sister twins, who, at the beginning of the last century, were born united at the lower part of the back, and attained their twenty-second year in this state. They were, as is well known, of very different temperaments, although dissection discovered that their sanguiferous systems anastomosed so considerably that the blood of both must have been the same."

[c] " Kant, l. c. p. 257. sq."

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* The same is of course as true of the brain and cerebral functions; and no one perhaps is perfectly happy in himself.

The *sanguineous* temperament is denoted by a full habit, rather soft fibre, a delicate skin, with large veins, a fresh complexion; often red or yellow, and, occasionally, darkish hair; great sensibility, a quick pulse, free secretions, and a cheerful disposition.

The *melancholic*, on the contrary, often by a spare habit, by a firm fibre, a thick, dark, hairy skin, black hair and eyes, and a dark complexion: a slow pulse, little sensibility, sparing secretions, and a gloomy cast of character; great perseverance in all pursuits, and constancy of passion.

The *choleric* lies between the two, and is marked by a softer fibre, a more irritable habit, a less dark and hairy skin, a more florid countenance, a quicker and stronger pulse, and a more irritable mind than the melancholic.

The *phlegmatic* is characterised by a lax and weak habit, a pale smooth skin generally destitute of hair, very light hair upon the head, a slow weak pulse, small blood-vessels, languid secretions, and dulness of mind and feeling.[d]

The cheerfulness of the sanguineous temperament, and the gloom and constancy of the melancholic, are subject to great exceptions, as they depend much upon the developement of certain parts of the brain.[e]

The temperaments may be mingled in greater or less number, (sanguineo-melancholic, &c. &c.) and in various proportions, so that, though we often see a temperament single and decided, we sometimes find it difficult to determine what the temperament is. Some talk of the nervous temperament, meaning that in which the excitability is great.[f]

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[d] See Dr. James Gregory's *Conspectus Med. Theoreticæ*, cap. xxii.

[e] Upon the independence of the character upon the temperament, see Gall, l. c. 4to. vol. ii. p. 245. sqq.; 8vo. t. ii. p. 142. sqq.

[f] "Besides the variety of temperaments, circumstances to which every individual is exposed increase, by influencing the *number*, as well as the *energy* and *vigour*, of the *functions*, the latitude in which the term health must be received. In regard to age, the health of a new-born infant is different from that of an adult; in regard to sex, it differs in a marriageable virgin and an old woman past child-bearing, and during menstruation and suckling; in regard to mode of life, it is different in the barbarous tribes of North America and in effeminate Sybarites. Moreover, in every person, custom (whose great power has obtained for it the title of second nature) has an extraordinary influence (Galen, *De Consuetudine*. G. E. Stahl, *De Consuetudinis Efficacia generali in Actibus vitalibus*. Hal. 1700. 4to. H. Cullen, *De Consuetudine*. Edinb. 1780.

A new view of temperaments, to use the author's expression, has been published by Dr. Thomas, of Paris.[g] He arranges them according to the predominance of the head, chest, or abdomen, — the mental, circulatory, or digestive organs: so that we have, — 1. The cranial or encephalic temperament: 2. The thoracic: 3. The abdominal: with their combinations,—4. The encephalo-thoracic: 5. The encephalo-abdominal: 6. The thoracico-abdominal; and, lastly, 7. The mixed, in which all three are equally blended. Men of genius or enterprise are of the first, Hercules may represent the second, Bacchus the third, and the Apollo Belvidere the last.

According to the *relative bulk* of the three regions, will be the *relative* energy of the mental, muscular, or abdominal functions.

The idea is exceedingly ingenious, and capable of extensive application[h]; but evidently does not interfere with the established view of temperaments. For every individual is, throughout his frame, of the sanguineous, or melancholic, &c., and at the same time has a particular proportion of each of the three regions to each other.

The author is wrong in terming these diversities temperaments, as they are not diversities of composition (*tempero*, I mix or proportion ingredients or constituents) but of relative developement of the three great divisions of the body.

Mankind have been classed according to their external appearance and to their structure: and the generally approved division of the chief *varieties* or *races* of mankind is that by Blumenbach.[i] He makes five varieties: — The Caucasian, Mongolian, Ethiopian, American, and Malay. The following are the characteristics of each.

1. The Caucasian. The skin white; the cheeks red,— almost a peculiarity of this variety; the hair of a nut-brown, running on the one hand into yellow and on the other into black, soft, long, and undulating.[k]

8vo. C. Natorp, *De Vi Consuetudinis.* Gött. 1808. 4to.) over every function, *v. c.* sleep, diet, &c."

[g] *Physiologie des Tempéramens ou Constitutions*, par F. Thomas, M.D. Paris, 1826.

[h] See the *Phrenological Journal*, Oct. 1827.

[i] *De Generis Humani Varietate nativa*, sect. iv.

[k] See *suprà*, p. 272. sq.

The head extremely symmetrical, rather globular; the forehead moderately expanded; the cheek-bones narrow, not prominent, directed downward from the malar process of the superior maxillary bone; the alveolar edge round; the front teeth of each jaw placed perpendicularly.

The face oval and pretty straight; its parts moderately distinct; the nose narrow and slightly aquiline, or at least its dorsum rather prominent; the mouth small; the lips, especially the lower, gently turned out; the chin full and round: — in short, the countenance of that style which we consider the most beautiful.

This comprehends all Europeans except the Laplanders and the rest of the Finnish race; the western Asiatics as far the Obi, the Caspian, and the Ganges; and the people of the North of Africa.

Dr. Morton[1] subdivides it into the 1. Caucasian; 2. Germanic; 3. Celtic; 4. Arabian; 5. Lybian; 6. Egyptian, or Nilotic; 7. The Indostanic families.

2. THE MONGOLIAN. The skin of an olive colour; the hair black, stiff, straight, and sparing.

The head almost square; the cheek bones prominent outwards; the space between the eyebrows, together with the bones of the nose, placed nearly in the same horizontal plane with the malar bones; the superciliary arches scarcely perceptible; the osseous nostrils narrow; the fossa maxillaris shallow; the alveolar edge arched obtusely forwards; the chin somewhat projecting.

The face broad and flattened, and its parts consequently less distinct; the space between the eyebrows very broad as well as flat; the cheeks not only projecting outward, but nearly globular; the aperture of the eyelids narrow — linear; the nose small and flat.

This comprehends the remaining Asiatics, except the Malays of the extremity of the Transgangetic peninsula; the Finnish races of the North of Europe, — Laplanders, &c.; and the Esquimaux diffused over the most northern parts of America, from Behring's Strait to the farthest habitable spot of Greenland.

Dr. Morton subdivides it into, 8. The Mongol Tartar; 9. The

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[1] *Crania Americana; or a Comparative View of the Skulls of various Aboriginal Nations of North and South America; to which is prefixed an Essay on the Varieties of the Human Species.* Illustrated by 78 plates and a coloured map, by S. G. Morton, M.D. Professor of Anatomy in Pennsylvania College, Philadelphia.

Turkish; 10. The Chinese; 11. The Indo-Chinese; 12. The Polar, families.

3. Ethiopian. The skin black; the hair black and crisp.

The head narrow, compressed laterally; the forehead arched; the malar bones projecting forwards; the osseous nares large; the malar fossa behind the infra-orbitar foramen deep; the jaws lengthened forwards; the alveolar edge narrow, elongated, more elliptical; the upper front teeth obliquely prominent; the lower jaw large and strong; the cranium usually thick and heavy.

The face narrow and projecting at its lower part; the eyes prominent; the nose thick and confused with the projecting cheeks; the lips, especially the upper, thick; the chin somewhat receding.

The legs in many instances bowed.

This comprehends the inhabitants of Africa; with the exception of those in the northern parts, already included in the Caucasian variety.

Dr. Morton divides it into, 17. The Negro; 18. The Caffrarian; 19. The Hottentot; 20. The Oceanic Negro; 21. The Australian; 22. The Alforian families, most numerous in New Guinea, the Moluccas, and Magindano.

4. The American. The skin of a copper colour[m]; the hair black, stiff, straight, and sparing.

The forehead short; the cheek-bones broad, but more arched and rounded than in the Mongolian variety, not, as in it, angular and projecting outwards; the orbits generally deep; the forehead and vertex frequently deformed by art; the cranium usually light.

The face broad, with prominent cheeks, not flattened, but with every part distinctly marked if viewed in profile; the eyes deep; the nose rather flat, but still prominent.

This comprehends all the Americans excepting the Esquimaux.

Dr. Morton divides it into, 15. The American; 16. The Toltecan, families. The Toltecan family bears evidence of centuries of demi-civilisation. The American family embraces all the barbarous nations of the New World, except the Polar tribes or Mongol Americans. The Esquimaux and especially the Greenlanders are generally regarded as a partially mixed race, among whom the physical characters of the Mongolian predominates, while their language presents obvious analogies to that of the Chippewyans, who border on them to the south.

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[m] Dr. M'Culloch considers that the colour is more that of cinnamon; and Dr. Morton that the American would more properly be termed the brown race.

5. THE MALAY. The skin tawny; the hair black, soft, curled, thick, and abundant.

The head rather narrow; the forehead slightly arched; the parietal bones prominent; the cheek-bones not prominent; the upper jaw rather projecting.

The face prominent at its lower part; not so narrow as in the Ethiopian variety, but the features, viewed in profile, more distinct; the nose full, broad, bottled at its point; the mouth large.

This comprehends the inhabitants of the Pacific Ocean, of the Marian, Philippine, Molucca, and Sunda Isles, and of the peninsula of Malacca.

Dr. Morton divides it into, 13. The Malay; 14. The Polynesian (South Sea Island), families.

In the primitive periods of the world, the boundaries between the habitations of these races were more distinct. Those between the Caucasian and Mongolian are vague. In Dr. Morton's map, the line adopted runs from the Ganges in a north-western direction to the Caspian Sea, and thence to the River Obi in Russia. "At a comparatively late period, however, several Mongolian nations have established themselves in Europe, as the Samoyedes, Laplanders, &c." The Ethiopian line is drawn north of the Senegal River, obliquely east and south to the frontier coast of Abyssinia, and thence to Cape Guardafui, thus embracing the Atlas Mountains. "Of the latter little is known; but many Negro nations inhabit to the north of them, at the same time that the Arab tribes have penetrated far beyond them to the south, and in some places have formed a mixed race with the natives."

General Remarks. The colour of the hair thus appears somewhat connected with that of the skin, and the colour of the iris is closely connected with that of the hair. Light hair is common with a white and thin skin only, and a dark thick skin is usually accompanied by black hair; if the skin happens to be variegated, the hair also is variegated; with the cream-white skin of the albino [n], we find the hair of a peculiar yellowish white tint; and, where the skin is marked by reddish freckles, the hair is red. When the hair is light, the iris is usually blue; when dark, it is of a brownish black; if the hair loses the light shade of infancy, the iris likewise grows darker, and when the hair turns grey in advanced life, the iris loses much of its former colour; the albino has no more colouring matter in his chorioid or iris than in his skin, and they therefore allow the redness of their blood to appear, the latter being of a pale rose-colour and semi-pellucid, the former, from its greater vascularity, causing the pupil to be intensely red; those animals only whose skin is subject to

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[n] Human albinos are men of preternaturally white skin, yellowish white hair, and red eyes. They spring up among all races and families of men; and they

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are not accounted for except when descended from albinos; for this variety of body may be hereditary no less than it is connate and irremediable by art, although colouring matter has been deposited in the hair and eyes, and probably in the skin, of some albinos as they grew. It is known to be common to some mammalia and birds, but has never been observed by Blumenbach in cold-blooded animals. (l. c. § 78.) A white rabbit is an instance of an albino. An albino is a monster by defect; an animal destitute of colouring matter in the skin, eyes, and nearly so in the hair. The absence of the pigmentum nigrum renders the eyes extremely sensible to light, whence such persons prefer going out in the evening. In Wafer's well-known and amusing account of those he found in the isthmus of Darien, he says, " They see not well in the sun, poring in the clearest day; their eyes being weak, and running with water if the sun shine towards them; so that in the day time they care not to go abroad, unless it be a cloudy dark day. Besides they are a weak people in comparison of the others, and not very fit for hunting and other laborious exercises, nor do they delight in such, but notwithstanding their being thus sluggish and dull in the day time, yet when moonshiny nights come, they are all life and activity, running abroad and into the woods, skipping about like wild bucks; and turning as fast by moonlight, even in the gloom and shade of the woods, as the other Indians by day, being as nimble as they, though not so strong and lusty." (Dampier's *Voyages.*)

There are imperfect albinos; or rather instances of less defect than constitutes an albino. For, as there are among us persons with faintly coloured rete mucosum and hair and faintly blue eyes, whom very little more defect of colouring matter would make albinos: — so among Negroes occur individuals with the general Negro conformation, who have dead-white skins, but reddish and sometimes reddish brown or even blue and usually weak eyes; sometimes skin like that of Europeans, but reddish and weak, or faintly blue, eyes, and occasionally black eyes, so that sometimes there is an approach to the character of the white varieties, with more or less of the albino character. Sometimes there is only a mulatto skin and red hair, — an approach to the European without any albino mark.

The skin of these Negroes cracks and even bleeds from the action of the sun.

Blumenbach was the first who conjectured the true nature of the peculiarities of the albino.

varieties, vary in the colour of the iris; and if the hair and skin happen to be variegated, the iris is observed likewise variegated.[o]

The Caucasian head, nearly round, is the mean of the rest; while the Mongolian, almost square, forms one extreme, having the American intermediate, and the Ethiopian the other extreme, having the Malay intermediate, between it and the Caucasian.

The Caucasian variety of face is also the mean, while the Mongolian and American, extended laterally, form one extreme, and the Ethiopian and Malay, extended inferiorly, constitute the other. In the first of each extreme, *viz.* the Mongolian and Ethiopian, the features are distinct; while in the second, *viz.* the American and Malay, they are somewhat blended.

Although this division of mankind is well founded and extremely useful, it is liable, like every artificial division of natural objects, to many exceptions. Individuals belonging to one variety are not unfrequently observed with some of the characteristics of another[p]; the characteristics of two varieties are

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[o] The hair is frequently of different shades in different parts.

John Hunter remarked that the iris in brutes agrees principally with the colour of the eyelashes.

However various the colour of the hair in horses, the iris, he also observes, is always of the same. But then the hair is always of the same at the birth, and the skin does not participate in its subsequent changes, being as dark in white as in black horses. In cream-coloured horses, indeed, there is an exception, — the iris agrees with the hair, but then the foals are originally cream-coloured and the skin is cream-coloured. (J. Hunter, *On the Colour of the Pigmentum of the Eye in different Animals*, l. c. p. 247.)

[p] "Sooty blackness is not peculiar to the Ethiopian, but is occasionally found in other varieties of men very different and remote from each other, in the Brazilians, Californians, Indians, and some South Sea Islanders; and among the latter, the New Caledonians form an insensible transition with the chestnut-coloured inhabitants of Tongatabu from the tawny Otaheitans to the black New Hollanders." (Blumenbach, l. c. § 43.)

"Although the Americans thus possess a pervading and characteristic complexion, there are occasional and very remarkable diversities, including all tints from a decided white to an unequivocally black skin." (Dr. Morton.)

"Some tribes of Ethiopians have long hair (Bruce on the Gallas; African Institution on the people of Bornu); on the contrary, some copper-coloured people have the crisp hair of the Ethiopian (the inhabitants of the Duke of York's Island, near New Ireland; vide Hunter, *Historical Account of the Proceedings at Port Jackson*). Again, the hair of the New Hollanders, specimens of which I have now before me, is so perfectly intermediate between the crisp hair of the often intimately blended in the same individual (indeed all the four varieties run into each other by insensible degrees)[q]; and

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Ethiopian and the curly hair of the islanders of the Pacific Ocean, that there has been much diversity of opinion, from the first Dutch to the latest English travellers, to which of the two varieties it should be referred. As to the varieties of colour existing among nations whose hair is usually black, we have sufficient authority for asserting that numerous instances of red hair occur in all the three last varieties." (Blumenbach, l. c. § 52.)

"The Caffres and the people of Congo have hair not unlike that of Europeans. Even the Foulahs, one of the Negro tribes of Guinea, have, according to Mr. Park, soft, silky hair: on the other hand, the inhabitants of many other countries resemble the Africans in their hair, as the savages of New Guinea, Van Diemen's Land, and Mallicollo. And in the same island some of the people are found with crisp and woolly, others with straight hair, as in the New Hebrides. In New Holland there are tribes of each character, though resembling in other particulars." (J. C. Prichard, M.D., *Researches into the Physical History of Man*, Ed. 1. p. 83.)

In some of the group of the New Hebrides, as Tanna, Annaton, Immer, &c., the people twist their locks of hair with the fibre of a plant so as to make their hair hang straight over the shoulders. Mr. George Bennett informs me that he has seen woolly hair in these islands, rendered straight by this mode; but naturally straight hair in New South Wales only.

"Many tribes of the Negro race approach very near to the form of Europeans. The Jaloffs of Guinea, according to Park, are all very black, but they have not the characteristic features of the Negro, — the flat nose and thick lips: and Dampier assures us that the natives of Natal in Africa have very good limbs, are oval-visaged, that their noses are neither flat nor high, but very well proportioned, that their teeth are white, and their aspect altogether graceful. The same author (Dampier's *Voyages*) informs us that their skin is black, and their hair crisped. Nor are others of this diversity more constant. In the native race of Americans, some tribes are found, who differ not in the characters in question from Europeans. 'Under the 54° 10′ of north latitude,' says Humboldt, 'at Cloak-bay, in the midst of copper-coloured Indians, with small long eyes, there is a tribe with large eyes, European features, and a skin less dark than that of our peasantry.' Humboldt's *Essay on New Spain*, translated." (Dr. Prichard, l. c. p. 62. note b.)

"The features of the inhabitants of the Friendly Islands are very various, insomuch that it is scarcely possible to fix on any general likeness by which to instances continually occur of deviation in one or more particulars from the appearances characteristic of any variety[r]; so that the assemblage rather than individual marks must frequently be employed to determine the variety.

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[q] "The Tartars of the Caucasian variety pass by means of the Kirghises and neighbouring people into the Mongoles, in the same manner as these by means of the people of Thibet into the Indians, by means of the Esquimaux into the Americans, and by means of the Philippine Islanders even in some measure into the Malays." (Blumenbach, l. c. § 86.)

It appears that the affinities of the languages of the various races of mankind do not alter with this arrangement according to external appearance; — that people are united by affinities of some kind or other in regard to language who belong to different varieties of form, and *vice versâ*.[s]

Particular Remarks. The Caucasian race is pre-eminent in all those mental and corporeal particulars which distinguish man from brutes. It is to the two sexes of this variety that Milton's lines apply, —

> "For contemplation, he and valour, formed;
> For softness she, and sweet attractive grace."[t]

The cranium is very capacious, the area of the face bears to its area but a proportion of one to four, and projects little or not at all at the lower parts: the intellectual faculties of its individuals are susceptible of the highest cultivation, while the senses of smelling, hearing, and seeing are much less acute than in dark nations. Philosophy and the fine arts flourish in it as in their proper soil.

The Ethiopian race when instructed by the Caucasian has produced instances of mental advancement great indeed, but inferior to what the latter is capable of attaining. "There scarcely ever," says Hume, "was a civilized nation of that com-

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characterise them, unless it be a fulness at the point of the nose, which is very common. But on the other hand we met with hundreds of truly European faces, and many genuine Roman noses among them." (Cook's last Voyage. Vol. I. 330.)

"Similar examples," remarks Blumenbach on this passage (l. c. § 55. note) "are observed among Ethiopian and American nations; and, *vice versâ*, the resemblance of individual Europeans to Ethiopians and Mongoles is very frequent and has become even proverbial."

[r] See note [p]. p. 1067.

[s] See Dr. Prichard's Abstract of a Comparative Review of Philological and Physical Researches as applied to the history of the human species in the *Report of the First and Second Meeting of the British Association for the Advancement of Science.* London, 1833.

[t] *Paradise Lost*, book iv. 297.

plexion, nor even an individual, eminent either in action or speculation. No ingenious manufactures amongst them, no arts, no sciences. On the other hand, the most rude and barbarous of the whites, such as the ancient Germans, the present Tartars, have still something eminent about them, in their valour, form of government, or some other particulars."[u] Blumenbach, however, possesses English, Dutch, and Latin poetry written by different Negroes, and informs us that, among other examples of distinguished Negroes, a native of Guinea, eminent for his integrity, talents, and learning, took the degree of Doctor in Philosophy at the University of Wittemberg, and that Lislet of the Isle of France was chosen a corresponding member of the French Academy of Sciences. "Provinces of Europe," says he, "might be named, in which it would be no easy matter to discover such good writers, poets, philosophers, and correspondents of the French Academy; and, on the other hand, there is no savage people which have distinguished themselves by such examples of perfectibility, and even capacity for scientific cultivation, and, consequently, that none can approach more nearly than the Negro to the polished nations of the globe."[x] This mental inferiority is attended of course by a corresponding inferiority of the brain. The circumference, diameters, and vertical arch of the cranium being smaller than in the European[y], and the forehead particularly being narrower and falling back in a more arched form, the brain in general, and particularly those parts which are the organs of intellect properly so called, must be of inferior size. The orbits, on the contrary, and the olfactory and gustatory, or, rather, masticatory, organs being more amply evolved, the area of the face bears a greater proportion to the area of the skull,— as 1·2 to 4; the proportion is greater in the orang-outang, and in the carnivora nearly equal.[z] The senses here situated, as well as that of hearing, are astonishingly acute, though not only in this, but also in the three following varieties, and the corresponding nerves, at least the first, fifth, and facial, of great size.[a]

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[u] Hume, *Essays.* Part 1. Essay 21. note M.

[x] *Beyträge zur Naturgeschichte,* th. i. p. 98.

[y] Sömmerring, *De basi cranii et originibus nervorum cranio egredientium.*

[z] Cuvier, *Léçons d'Anatomie Comparée.*

[a] Soemmerring, l. c.

The native Americans pursue their enemies through the desert by the sense of

The ossi nasi lie so flatly as to form scarcely any ridge; the face, as we have formerly seen, projects considerably at its lower part[b]; the lower jaw is not only long but extremely strong; the

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smell, and have distinct terms for the odour of a European, a Negro, and an American Indian. (Humboldt, *Political Essay on New Spain*. Translated. vol. i. p. 245. Haller, *El. Phys.*) The Kalmuks have extraordinary smell, sight, and hearing: and perhaps careful examination would prove that their taste, if not touch, is very acute. They scent fires and camps at a great distance, and have only to be near the habitation of a brute to know whether it is there or not. They lie flat on the earth with their ear to the ground, and at a still more extraordinary distance learn the noise of cavalry in march, the place occupied by a suspected enemy, by a herd of brutes, or even a solitary one. " The greater part of Kalmuks can discover upon the plain steppe the smallest objects — the dust caused by a drove of cattle, or a body of cavalry, notwithstanding the difficulties which occur during the summer, the peculiar undulation of the surface of the ground, and the vapours which arise from it in a pure atmosphere, during the great heat of these countries. In the expedition which Oubachi, vice-khan of the Torgots, made against the people dwelling below Kouban, the Kalmuk army would certainly have missed the enemy had it not been for a Kalmuk of the common class, who, whilst he was feeding the horses, discovered from a moderately elevated position at the distance of 30 versts, the smoke and dust of the enemy's army. He pointed it out immediately to those not less accustomed than himself, whilst Colonel Kidimski, even by the assistance of a telescope, could perceive nothing." (Dr. Prichard, *Researches, &c.* Ed. 3. vol. i. p. 264. sq.) Negroes in the Antilles can distinguish blacks from whites in pursuit by the same sense. The body of every man has doubtless a peculiar odour, though the inferior races only enjoy the sense of smell sufficiently acute to make very nice distinctions in regard to it. In them, too, the odour is much stronger. I recollect walking one night, many years ago, with a physician to the house of a poor man in the suburbs of London. The wife came to the door with a candle in her hand, and, opening a dark room on one side of the passage, begged me to walk into it while she lighted the physician to her husband. My nose was presently struck by a very strong smell, something like that of the outsides of bacon, indeed exactly that of some specimens of creosote. At the return of the light I perceived three or four little mulattos asleep in a sort of bed, and after leaving the house the physician informed me that the woman's husband was a black.

[b] Camper (*Dissertation Physique sur les Différences réelles, que présentent les Traits du Visage chez les Hommes de différens Pays et différens Ages*) gives the following proportions of the facial angle:

European - - -	80 or 90
Chinese - - -	75
Negro - - -	70
Orang-outang - - -	58
Monkey - - -	42

chin not only not prominent but even receding, and the space between it and the lower teeth is small, while that between the upper teeth and the nose is large; the meatus auditorius is nearer the occiput, — more remote from the front teeth than in the European; the foramen magnum occipitale lying farther back, (but this is now denied by Dr. Prichard[c]), the occiput is nearly in a line with the spine; the body is slender, especially in the loins and pelvis, whose cavity likewise is small; the length of the fore-arms and fingers bears a large proportion to that of the os humeri; the os femoris and tibia are more convex, and the edge of the latter, according to a remark of the late Mr. Fyfe of Edinburgh to me, very sharp; the calves are placed high; the os calcis, instead of forming an arch, is on a line with the other bones of the foot, which is of great breadth; the toes are long; the penis large and frequently destitute of frænum. Mr. White, from whom many of these remarks are derived, describes the testes and scrotum as small. Dr. Billmann of Cassell has observed that the stomach is shorter, and more globular at its cardiac extremity; and the observation is confimed by Soemmerring, who finds that of the ape still shorter[d]; the skin is thicker[e], and, finally, the term of life generally shorter, that in Europeans.

Nearly all these facts demonstrate rather a less distance of the Ethiopian than of the European from the brute creation. But with

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Mr. White of Manchester (*Essay on the regular Gradation*) states them rather differently:

European	80	to 90
Asiatic	75	80
American	70	75
African	60	70
Orang-outang	50	60
Monkey	40	50

Cuvier gives 75° for the facial angle of the young orang-outang, l. c. viii. Art. i.

[c] l. c. vol. i. p. 290. Ed. 3. 1836.

[d] *Mem. of the Bavarian Acad. of Sciences*, vol. viii. p. 77. sqq.

[e] The temperature of the Negro has been said to be two degrees cooler than that of Europeans: and the voluptuous therefore to prefer a Negress in summer, a fair Circassian in spring and autumn, and an European brunette in winter. M. Douvier, however, asserts that the temperature of Negroes is higher than that of whites. (*Journ. de Chimie*, 1832, p. 97.)

an inferiority to the Caucasians so slight if compared with his immense superiority over the most intelligent brutes, so insensibly running into the Caucasian and all the other varieties in point of intellect, so liable to innumerable diversities of conformation though he does bear some resemblance to brutes, and so certainly bearing no more resemblance to them in some points nor so much in others as many tribes of other varieties, the poor Negro might justly class those of us who *philosophically* view him as merely a better sort of monkey, or who desire to traffic in his blood, not only below himself but below apes in intellect, and below tigers in feeling and propensity.

> "Indica tigris agit rabida sum tigride pacem
> Perpetuam. Sævis inter se convenit ursis."[f]

Professor Tiedemann says that the average weight of European brains is from 3 lbs. 2 oz. to 4 lbs. 6 oz. troy: but the average of four Negro brains, from which he drew his conclusion, will be found to be only 3 lbs. 5 oz. 1 dr., or 3 oz. above the *lowest* European average; and the *highest* Negro brain falls 5 oz. short of the highest *average* European, and no less than 10 oz. short of Cuvier's brain, which weighed 4 lbs. 11 oz. 4 dr. 30 grs. Dupuytren's weighed 4 lbs. 10 oz.

If we take the average of the length of the brains of the four Negroes, it will be found to be 5 inches 11 lines: but that of seven European males, which he examined for comparison, 6 inches 2$\frac{1}{7}$ lines. The average greatest breadth 4 inches 8$\frac{1}{6}$ lines in the former: 5 inches 1$\frac{1}{7}$ line in the latter. The average height is 2 inches 11$\frac{1}{3}$ in three of the four Negroes: 3 inches 4 lines in the Europeans. He adds that "the anterior portion of the hemispheres is somewhat narrower than is usually the case with Europeans."

The average capacity of 41 Negro skulls in his tables will be found to be 37 oz. 1 dr. 20 grs., or, if those which were female are subtracted, 37 oz. 6 dr. 18 grs.: that of 77 European skulls of every nation, in his own tables, 41 oz. 2 dr. 30 grs.[g] Dr. Morton, however, after examination of 29 skulls of unmixed Negroes, 9 of them native Africans, states the mean internal ca-

[f] Juvenal. *Sat.* xv. 163.

[g] *Phil. Trans.* 1836, Pt. ii.

pacity of Caucasian skulls to be 87 cubic inches: and of the Negro to be only 78.[h] The most capacious European skull was 109: the least 75. The most capacious Negro skull, 98: the least 65.

In the face of his own results, Dr. Tiedemann declares that the opinion of Camper, Soemmerring, Lawrence, Virey, Cuvier, &c., — that the Negro has a smaller skull and brain than the European, is "*ill founded and entirely refuted by my researches!*" he declares that the weight and the size of the Negro brain is as great as those of the European! "Here, then, on Tiedemann's own showing," says Dr. Andrew Combe, who has pointed out these contradictions[i], "we have, first, an inferiority in the dimensions of the Negro brain, and a greater narrowness of its anterior lobe; and secondly, a marked inferiority in the capacity of the Negro skull to the extent of about $\frac{1}{10}$; and yet he very strangely infers that *both are equal* to those of the European: and the Royal Society, and half our scientific men and journals, adopt and propagate both facts and inferences as literally correct and of vast importance! If the phrenologists had perpetrated such a series of blunders, Sir William Hamilton and his allies would have shouted in triumph over their stupidity." But science has other cause to blame the medical members of the Council of the Royal Society for disgracing the *Transactions* with Professor Tiedemann's paper; the principal purpose of which was to prove that neither anatomy nor physiology can justify our placing even the Negro beneath the European in a moral and intellectual point of view.[k] They ought to have known that, had he shown the Ethiopian brain to be as large as the European, he would not thereby have shown that the Ethiopian intellect was equal to the European. There is no fact better established in nature than that the different parts of the brain, like different parts of the nervous system at large, have different functions: and that some parts are destined for intellectual and some for moral functions or feelings. As the size and weight of the brain must depend upon the size and weight of both these, it is evident that two brains may be of equal size, and yet the one be very large in portions devoted to intellect and small in those devoted to the feelings: while another is poor in the intellectual portions and large in those devoted to the feelings: and a brain may be large or small in regard to certain intellectual or moral powers only. If the medical members of the Council did not know these things, their ignorance rendered them unworthy of their seats. —"*Sic parvis componere magna*"—they, and Professor Tiedemann, remind us of Cassini and Miraldi who were calculating the paths of comets on the most imaginary and unfounded hypotheses long after Halley had constructed tables, on the principles of Newton, in which the motions of all comets that ever have or could appear might be easily deduced. They stand surrounded by myriads of phrenological facts and see them no more than the wild animals see the geology of the tracts which they inhabit.[1]

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[h] *Crania Americana.*

[i] *Remarks on the Fallacy of Professor Tiedemann's Comparison of the Negro Brain and Intellect with those of the European*, in G. and A. Combe's Translation of Gall on the *Functions of the Cerebellum, and Answers to the Objections urged against Phrenology by Drs. Roget, Rudolphi, Beclard, and Tiedemann.* Edinb. 1838.— a work in which the ignorance of phrenology, the inconsistencies, and feebleness of these anti-phrenologists is admirably exposed; also *Phren. Trans.* No. lii.

[k] p. 525.

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[1] It is amusing to observe poor Dr. Tiedemann advancing to phrenology. Not many years ago it was thought wicked by many and absurd by others to consider the brain as the organ of the mind. When Sir Joseph Banks ruled the Royal Society, his parasite, Sir Everard Home, so influenced the fellows, that at Sir Joseph's Sunday assemblies I have heard it stated that no facts showed the brain to have more than the foot to do with the mind. Then, as to the idea of size having any relation with power, that is scoffed at still. But Dr. Tiedemann in his paper says, "The brain of men who have distinguished themselves by their great talents is often very large." "The brain of men endowed with but feeble intellectual powers is, on the contrary, often very small, particularly in congenital idiotism. The brain of an idiot 50 years old weighed but 1 lb. 8 oz. 4 dr.: and that of another at 40 years of age weighed but 1 lb. 11 oz. 4 dr."—"It is remarkable that the brain of a man 82 years old was very small, and weighed but 3 lbs. 2 oz. 3 dr.: and the brain of a woman above 80 years old weighed but 2 lbs. 9 oz. 1 dr. I have generally found the cavity of the skull smaller in old men than in middle-aged persons. It appears to me therefore probable, that the brain really decreases in old age, only more remarkably in some persons than in others." This is pretty well. But he now becomes bolder. "There is undoubtedly a very close connection between the absolute size of the brain and the intellectual powers and functions of the mind. This is evident from the remarkable smallness of the brain in cases of congenital idiotism, few such exceeding in weight the brain of a new-born child." "The brain of very talented men is remarkable on the other hand, for its size!"

Dr. Tiedemann proceeds. "Tyson" (*The Anatomy of a Pygmy*) "was the first

"The unconscious admiration which that traveller detected himself in bestowing on the native beauties, affords," says the

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who dissected the brains of an orang-outang, and of a Jocko or Chimpanzee, and says he found no difference between them and the human brain. His own words are, 'The brain is reputed the more immediate seat of the soul itself; one would be apt to think that since there is so great a disparity between *the soul of a man and a brute*, the organ likewise in which it is placed should be very different too: though by comparing the brain of our Pygmie with that of a man and examining with the greatest exactness each part in both, it was very surprising to me to find so great a resemblance of the one to the other, *that nothing could be more*.' Buffon, relying on Tyson's researches says, 'Le cerveau de l'orang-outang est absolument de la même forme et de la même proportion, et *il ne pense pas*; y-a-t-il une preuve plus evidente, que la matière seule, quoique parfaitement organisée, ne peut produire ni la pensée ni la parole, qui en est le signe, à moins qu'elle ne soit animée par un principe superieur.'" Dr. Tiedemann then subjoins that his dissections prove the brain of the orang-outang as well as that of monkeys to differ from the human brain in being absolutely and relatively smaller and lighter, shorter, narrower and lower; smaller comparatively with the size of the nerves; the hemispheres smaller relatively to the chorda spinalis and oblongata, cerebellum and corpora quadrigemina, thalami, and corpora striata; and in having fewer gyri and sulci. He does not remind his readers that Gall had represented the brain of an orang-outang in his Atlas, and written these words above 20 years before:—"Buffon allowed himself to believe, through the false observations of Tyson, that the brain of the orang-outang is identical with the human. However, Tyson contradicted himself; for, while in one passage he declares the cranial bones of the orang-outang to resemble exactly those of men, he in another part points out a great difference with respect to the frontal and the orbits." "The dimensions of its brain are at the utmost those of a new-born child. Besides, its difference from the human in its shape and convolutions are such as must strike the humblest observer." (4to. vol. ii. p. 368. 1812.) "In the first place, the difference of their volume is as 5 to 1, their convolutions differ considerably in number and structure; the anterior lobes, especially, are contracted into a cone, flattened above, hollow below; and the difference is still more remarkable in other simiæ." (8vo. t. vi. p. 278.; see *suprà*, p. 34.) Was Dr. Tiedemann ignorant of this? I am convinced he was not; for the passage is in the volume of Gall which contained 118 pages of powerful exposure of the errors and injustice that exist in Dr. T.'s anatomy of the brain and the writings of two of his French supporters. He must have presumed upon a large share of ignorance in the Royal Society when he transmitted to it a paper so replete with error, and written as if Gall's discoveries had never been made. He thus continues.

"Desmoulins (*Journal de Physique*, 1820.) is of opinion that the brain decreases in size in old people. From this circumstance he explains the diminution of the functions of the nervous system and intellectual powers. The truth writer of a critique of Major Denham's *Travels in Africa*[m], "one more example of this truth, — that, however much Europeans may have doubted whether Negroes were men, there has never been a difference of opinion as to whether Negresses were women."

The skin of the Negro has a peculiar velvet-like softness, and is lubricated by an oily secretion.

The Malays have but little hair upon the chin, and possess a great developement of the sides of the head above the ears.

The Mongolians are remarkably square and robust; their shoulders high; their extremities short and thick.

The Americans have small hands and feet, and are nearly destitute of beard. Shorter in the forehead than the Mongolians, they have not so great intellectual distinction.

The greatest difference between the Toltecan and American family is in the intellectual faculties. "In the arts and sciences of the former are seen the evidences of an advanced civilisation. From the Rio Gila in California, to the south-eastern extremity of Peru, their architectural remains are every where encountered to surprise the traveller and confound the antiquary; among these are pyramids, temples, grottoes, bas-reliefs, and arabesques; while their roads, aqueducts and fortifications, and the sites of their mining operations, sufficiently attest their attainments in the practical arts of life." "The desert of Atacama divides the

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of this assertion has not yet been determined." (p. 502.) Gall is not worthy to be quoted on this point! "I have generally found the cavity of the skull smaller in old men than in middle-aged persons. It appears to me therefore probable that the brain really decreases in old age." (p. 502.) Why Gall had said many years before, from extensive research,—"as age advances the brain lessens, wastes, shrinks." (8vo. t. ii. p. 158.) At about 60, "the brain begins to decline," and "the anterior inferior parts diminish sooner than the others." (p. 431.; also t. iii. p. 48.) "In extreme old age the brain atrophies and senile dementia takes place." (t. iii. p. 51.) "All the cerebral mass lessens towards old age, but not equally so in all parts at the same time." (p. 149.) See 4to. vol. ii. p. 256. sq. 407. sq. 1812.

Dr. T. asserts that "the brain arrives, on an average, at its full size towards the 7th or 8th year!" "Gall and Spurzheim are of opinion that the brain continues to grow till the 14th year." Why Gall says "the brain of most men has hardly arrived at its full growth before 30 years: often not before 40." (4to. vol. iii. p. 17.; 8vo. t. iii. p. 31.)

[m] *Westminster Review.* 1826.

kingdom of Peru from that of Chili, and is nearly 100 miles in length: a river abounding in salt runs through it. This desert was the favourite sepulchre of the Peruvian nations for successive ages. The climate, salt and sand, dry up the bodies; and the remains of whole generations of the former inhabitants of Peru may now be examined, after the lapse perhaps of thousands of years." At a cemetery of ancient Peruvians, for example, near Arica, the surface is covered with sand an inch or two deep, under which is a stratum of salt 3 or 4 inches in thickness that spreads all over the hill. The bodies are in a squatting posture, with the knees drawn up, and the hands applied to the sides: and all "enveloped in a coarse but close fabric with red stripes, which has withstood, wonderfully, the destroying effects of ages, for these interments were made before the conquest." "Dr. Morton has been enabled to examine nearly 100 Peruvian crania, and concludes that that country has been, at different times, peopled by two nations of differently formed crania, one of which is perhaps extinct, or at least exists only as blended by adventitious circumstances, in very remote and scattered tribes of the present Indian race." "Of these two families, that which was antecedent to the appearance of the Incas is designated as the *ancient Peruvian*, of which the remains have been found only in Peru, and especially in that division of it now called Bolivia. Their tombs, according to Mr. Pentland, abound on the shores and islands of the great Lake Titika, in the inter-alpine valley of the Desaguadera, and in the elevated valleys of the Peruvian Andes, between the latitudes of 14° and 19° 30′ South." "Our knowledge of their physical appearance is derived solely from their tombs." The extinct group in Peru was succeeded by the Incas or modern Peruvians, who date their "possession of Peru from about the eleventh century of our era; and, as this period corresponds with the epoch of the migration from Mexico of the Toltecas,—the most civilised nation of ancient Mexico, Dr. Morton concurs in the opinion expressed by other authors, that the modern Peruvians were of a common origin with the ancient Mexicans." "The modern Peruvians differ little in person from the Indians around them, being of the middling stature, well limbed, and with small feet and hands. Their faces are round: their eyes small, black, and rather distant from each other; their noses are small, their mouth somewhat large, and their teeth remarkably fine. Their complexion is a dark brown;

and their hair long, black, and rather coarse." Their civilisation and comparative refinement were blended with some remains of the ferocity of the savage. "Matrimonial engagements were entered into with very little ceremony or forethought, and they were as rudely set aside at the option of the parties. Polygamy was lawful but not prevalent." "Incontinence, sensuality, and child-murder, were common. Their diet was chiefly vegetables. The people were indolent, filthy, and negligent in their persons. The hair of their mummies, in many instances, is charged with desiccated vermin. Their religious system was marked by great simplicity, and was divested of those bloody rites which were common with the Aztecs of Mexico. They believed in one God, whom they called Viracocha, in the immortality of the soul, and in rewards and punishments in the next life. They worshipped both the sun and the moon, in whose honour they erected temples and formed idols. They consecrated virgins in the same manner as practised in modern convents. Their funeral rites were barbarous and cruel: when their chief men died, they burned a number of human victims, women, boys, servants, to attend on the departed in the next world. They were conquered by Pizarro with a force which consisted of 62 horsemen and 202 foot soldiers." "The skull in these people is remarkable for its small size, and for its quadrangular form. The occiput is greatly compressed, sometimes absolutely vertical; the sides are swelled out, and the forehead is somewhat elevated, but very retreating. The skulls are remarkable for their irregularity." Among 23 adult skulls of the pure Inca family, "the mean of the internal capacity is 73 cubic inches, which is probably lower than that of any other people now existing, not excepting the Hindoos." "The mean of the anterior chamber is 32; of the posterior 42; of the coronal region, 12 cubic inches. The highest measure of the coronal region is 20·5; and the smallest 9·25 cubic inches. The mean facial angle is 75 degrees. The heads of 9 Peruvian children appear to be nearly, if not quite, as large as those of children of other nations at the same age."

The small size of the brain of this family, compared with that of the Europeans who invaded them, is in accordance with the ease with which it was overcome and retained in subjection. "The deficiency in the posterior region of the brain, in which the organs of the domestic affections are situated, corresponds with their feeble conjugal attachment and indifference to the lives of their children." The diameter between the organs of the sense of construction is 4·5 inches, and between those of poetry 5·1. "These organs give a talent for art and are considerable. The same measurements in the Naumkeagh, the" group "which occupied New England, and whose skulls are still dug up near Boston and Salem, and which never made any attainments in the arts, are 4·1 and 4 inches, respectively. Dr. Robertson, in his *History of America*, mentions that the modern Peruvian" group "was distinguished for its extraordinary powers of concealment and secrecy: the breadth between the two organs of cunning, is 5·6 inches, which is large: the longitudinal diameter only 6·1." The organ of courage is very deficient.

"The barbarous nations possess a larger brain than the Toltecans; while, on the other hand, the Toltecans possess a greater relative capacity of the anterior chamber of the skull, in the proportion of 42·3 to 41·8. Again, the coronal region, though absolutely greater in the barbarous tribes, is rather larger in proportion in the demi-civilised tribes: and the facial angle is much the same in both, and may be assumed, for the race, at 75 degrees." Dr. Morton, whose labours were prosecuted without any view of supporting phrenology, confesses, in his Preface, "I am free to acknowledge that there is a singular harmony between the mental character of the Indian, and his cranial developements, as explained by phrenology."

Dr. Morton considers, "1. That the American race differs essentially from all others, not excepting the Mongolians: nor do the feeble analogies of language, and the more obvious ones, in civil and religious institutions and the arts, denote any thing beyond casual or colonial communication with the Asiatic nations; and even these analogies may perhaps be accounted for, as Humboldt has suggested, in the mere coincidence arising from similar wants and impulses in nations inhabiting similar latitudes. 2. That the American nations except the Polar tribes are of one race and species, but of two great families, which resemble each other in physical but differ in intellectual character. 3. That the cranial remains discovered in the mounds from Peru to Wisconsin belong to the same race, and probably to the Toltecan family.

"The American *family* itself contains several subordinate groups. 1. The Appalachian branch includes all the nations of North

America, except the Mexicans, together with the tribes north of the River Amazon and east of the Andes. 2. The Brazilian branch is spread over a great part of South America east of the Andes, viz. between the Rivers Amazon and La Plata, and between the Andes and the Atlantic, thus including the whole of Brazil and Paraguay north of the 35th degree of S. latitude. In character, these nations are warlike, cruel, and unforgiving. They turn with aversion from the restraints of civilised life, and have made but trifling progress in mental cultivation or the useful arts. In character, the Brazilian nations scarcely differ from the Appalachian; none of the American tribes are less susceptible of cultivation than these; and what they are taught by compulsion, in the missions, seldom exceeds the humblest elements of knowledge. 3. The Patagonian branch includes the nations south of the La Plata, to the Straits of Magellan, and the mountain tribes of Chili. They are for the most part distinguished for their tall stature, their fine forms, and their indomitable courage; of all which traits the Auracanians possess a conspicuous share. 4. The Fuegian branch, which roves over a sterile waste, computed to be as large as one half of Ireland. Forster computes their whole number at only 2000 persons. Their physical aspect is altogether repulsive, and their domestic usages tend to heighten the defects of nature. The expression of the face is vacant, and their mental operations are to the last degree slow and stupid."

Not only have the five races their distinctive characteristics, but the different nations comprehended in each variety have each their peculiarities, both mental and corporeal; among the Caucasians for example, the Germans, French, Spaniards, and English are extremely different from each other. Nay, the provinces of the same country differ, and the families of the same province, and, in fact, every individual has his own peculiar countenance, figure, constitution, form of body, and mental character. Each no doubt is as different from others in various points of his microscopic anatomy, his minute composition, and his minute delicacies of function and properties, as in countenance. Any one may have some extraordinary conformation, perhaps amounting to monstrosity, or some extraordinary property,— a real monstrosity in his physiology, such as susceptibility of deleterious influence from something which is innocuous to most others: or susceptibility of peculiar influence from some agents which affect most people in another manner. Innate disposition to certain organic or functional disease, independent of external agency, comes under the same head.

The degrees of native peculiarity of formation have different names. Hereditary changes, not consistent with soundness, that take place after an organ has existed for a shorter or longer time sound, are termed unhesitatingly diseases. But, if a part has an unusual anatomical character from birth, it is said to be malformed. Throughout nature, there is a great tendency to vary the means of all purposes. What is accomplished with one animal in one way, is accomplished differently with another: the varieties of nature's means for the same end are infinite. The same tendency to variety is observable in the structure of the same species and varieties of animals. In the human subject we are seldom disappointed in expecting the natural structure of the spine, great vessels, or important viscera; but it is not very uncommon to find the brachial artery dividing near the axilla, the obturatrix arising from the epigastric, the palmaris or plantaris muscle wanting, the biceps having an additional slip from the os humeri, or the latissimus dorsi one from the angle of the scapula, or the spleen accompanied by one or more little ones. These merit the name of *varieties* only; and in the arrangement of minute blood-vessels, the length of bony processes, and other little insignificant matters, there exists so much uncertainty that it would be difficult to say which is the natural structure. In truth, were we all alike, there would be the confusion of indistinguishableness. The existence of small moles can hardly be deemed even a variety; large ones may be considered such. Deviations of a more striking and uncommon character are called *lusus naturæ*. Such are the absence of colouring matter in the hairs and in the cutis and iris in Albinoes (*suprà*, p. 1066.); spots and patches of white in the skin of piebald Negroes; and of brown and black, often seen with tufts of hair, in truth, very large hairy moles, in whites; a different colour of the whole or of a portion of one iris, of the eyelashes of one eye, or of some of the hair of the head; the cuticle of the porcupine family (*suprà*, p. 270.); the course of the vena portæ to the inferior cava, without distribution in the liver (*suprà*, p. 96.); the malformations of the heart in the morbus cæruleus (*suprà*, p. 241.); the situation of the heart on the right side[n], and the general transposition of the thoracic and abdominal viscera[o]; oval irides; irides entirely deficient under the centre of the pupil; a bifid uvula, the two parts sometimes very distant, and the soft palate deficient above; a bifid glans penis, with two fræna; gill-like openings in the side of the neck at birth[p]; the termination of the urethra behind the glans, or in the vagina; a double uterus deficient vagina; deficiency of tendinous parietes of the abdomen, so that a connate ventral hernia exists; a supernumerary, whole or partial, thumb or toe: an instance of each of which, and more than one of several, I have myself seen with the exception of the unusual course of the vena portæ, and of the branchial openings in the neck. If the deviation among visible parts is still more considerable, and, indeed, though it be much less than those of invisible parts, but, by being obvious, greatly disfigures, it is termed a *monstrosity*. Such was the deficiency of the upper extremities from below the shoulders in Miss Biffin, whom most frequenters of English fairs must have seen, and of the arms and legs in Marc Catozze[q], the Venetian, whose hands were attached to his shoulders, and his feet to his hips or thighs; absence of the radius and ulna on one side, between the os humeri and hand, or of one or more metacarpal bones; absence of the front of the bladder and abdominal parietes, so that the ureters terminate and discharge urine externally; or of the phalanges; or an additional fore-arm and hand, or even head; are not so rare but that I have seen them also, and in the living subject. I have seen an additional[r] head in museums. Zacchias saw a globular head upon the clavicle without the intervention of a neck.[s] Extreme hairiness of the skin, such as described at p.275., is a monstrosity; the absence of gastrocnemii is a lusus naturæ.[t] Similar aberrations from nature's usual plans out of the animal kingdom were designated *ostenta*, *portenta*, *prodigia*[u], from the notion of their being ominous; whence the opinion of Cicero is highly probable that these aberrations in the forms of human beings are called *monstra* from the superstition of their pointing out something that will happen; not, as Licetus[x] contends, because they are shown as sights. Whatever may have been the reason of the appellation, it clearly implies something visible, obvious to all; which circumstance is the reason that mere degree of deviation does not constitute a monster, and that visible disfigurement is requisite to the idea; whence the definition of the most learned Zacchias, — "an animal formed *enormously* different from the goodness and simplicity of *figure* belonging to its species."[y]

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[n] I saw an instance of this in the museum at Edinburgh; it occurred also at the Hôtel Dieu. (Winslow, *Mém. de l'Acad.* 1743.) See three cases in Shenkius, p. 310.

[o] Sir Astley Cooper has lately made a beautiful preparation from an old woman whose abdominal and thoracic viscera were all so transposed.

[p] Eleven such cases are published by Mr. Ascherson at Berlin. See Dr. J. Johnson's *Med. Chir. Review*, April, 1834.

[q] *Eccentric Mirror*, vol. ii.

[r] I think there was shown me an additional head at the side of the other in a human fœtus, both at Edinburgh and Vienna, and once I witnessed this in a living calf. In the Hunterian Museum are the two skulls of a child that was the son of a native farmer in the East Indies and lived to be four years old. The additional one was placed upside down upon the top of the other. Each contained

Varieties, lusus naturæ, and monstrosities, may all be arranged accordingly as they are *excesses*, *deficiencies*, or *misplacements*. To this classification of monsters by Buffon[z] *unnatural formations*

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a brain, invested by its own dura mater, and the upper received its blood from the lower. The features of the upper head were sometimes unaffected when the lower head cried, and were never affected when it smiled. The gums of both were cut by front teeth. When the nipple was presented to the upper head, it made a slight attempt to suck. The tears of the upper head constantly ran over, but especially when the lower head cried. The eyes of the upper head would open on a sudden impression, but even then, as well as at all other times, were directed to no object: they remained open during sleep. The mouth of the upper head showed signs of gratification when the lower sucked. The upper head had much less sensibility. (*Phil. Trans.* vols. lxxx. and lxxxix.)

Winslow saw, in 1698, an Italian with an additional little head, attached by the lower half of the right side of the face and cranium to the thorax, below the cartilage of the third rib. It had been separately baptized, and the man felt if it was touched. (*Mém. de l'Acad. des Sc.* 1733.)

[s] l.c. *De Monstris.*

[t] Three cases will be found in M. Paletta's *Exercit. Patholog.*

[u] *Ostendere, portendere, prædicere.*

[x] *De Monstris.*

[y] l.c.

[z] *Histoire Naturelle,* Supplement. t. iv. p. 578.

are added by Blumenbach[a], as a part may be malformed, although neither excessive, defective, nor misplaced.[b]

Buffon's arrangement relates to whole organs; but, were it applied to portions of them also, Blumenbach's fourth class would be exceedingly small. For instance, when the anterior part of the urinary bladder and corresponding integuments are absent, the ossa pubis not conjoined, and the posterior part of the bladder projects between the recti abdominis muscles, forming, by its mucous lining, a soft, red, sensible protuberance on the lower part of the abdomen, contiguous at its circumference with the common skin, with the ureters opening upon it, and constantly allowing a free passage to the urine, this is really a case of deficiency as far as respects the bladder, integuments, and ossa pubis, and of misplacement as respects the recti muscles. Spina bifida is a case of deficiency; the hare-lip, which is often accompanied by a cleft in the palate also, and a bifid glans penis, again, are in fact examples of deficiency. Another instance adduced is a single cyclopic eye in the middle of the forehead, — a monstrosity which is a misplacement of each eye, for the organ is plainly always two united; or of a union of the two kidneys into one. The propriety of applying these subdivisions to deviations of portions as well as of the whole of organs is proved by the occasional deficiency or redundancy of portions only, *v.c.* when the arm between the shoulder and hand, or only the front of the urinary bladder, is absent. But the termination of the rectum in the bladder or vagina, its termination without an opening, and a vascular tumour of the skin called nævus, fairly belong to this fourth subdivision, they being instances neither of excess, defect, nor misplacement, but of unnatural formation.

Few cases are unmixed. Defect, excess, or misplacement, are often, sometimes indeed necessarily, combined with unnatural formation: and not unfrequently excess, defect, and unnatural formation, all make up the derangement together.

There may be different kinds of deviation in different parts of the same subject; and it is worthy of notice that considerable deviations are generally accompanied by minor ones of other parts. Spina bifida and club feet very frequently co-exist. When the brain is absent, so that the fœtus has no forehead and looks like a cat (called in Germany *katzenkopf*), there is often something wrong about the extremities or the viscera of the trunk; and absence of heart is said to be always accompanied by considerable deviations in other parts.

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[a] Although these arrangements are intended for monsters only by Buffon, and for the more striking malformations by Blumenbach, they may be applied to all deviations.

[b] *Handbuch der Naturgeschichte*, s. ii. See a compilation of malformations by Mr. Lawrence, *Med. Chirurg. Trans.* vol. v.

The highest degree of deviation may combine the extremes of more than one of the four subdivisions, and sometimes presents a being very like a brute. In old books we read of women bringing forth dogs, pigs, monkeys, nay, even lions, elephants[c], and fish[d], and even little devils with hoofs, claws, horns, tail, and a black skin[e], since intercourse with such beings was two centuries ago thought common enough and monsters were ascribed to it.

As an instance of the lowest degree of unnatural formation, I may mention a minute opening in the lachrymal sac on the side of the nose of a young lady whom I know: the highest degree is perhaps instanced in some malformations of the heart. The lowest degree of misplacement is exemplified when a testis is placed for life in the groin: the highest is perhaps witnessed in the transposition of the viscera.[f] The lowest degree of defect is instanced in the absence of a toe or the gall-bladder: the highest, where only the lower half of the trunk with the lower extremities, or only one extremity, exists. In excess the addition may be merely attached, or may be mingled with the same part into one larger. The lowest degree of excess is where there is an additional spleen or toe: the highest, where a considerable portion of a second being is attached. Zacchias saw at Rome, in 1617 and 1623, a well-formed handsome boy, named Lazarus Coloreto, from whose chest there grew another, with only one leg, and that too short; mutilated arms; a hideous face, a thick head unable to take food, perpetually dribbling, and with no sense but that of touch, which he showed by moving himself when pinched, and who had been christened John Baptist.[g]

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[c] Shenkius, *Obs. Med.* 691.

[d] Roederer, *Dissertation couronnée à Petersbourg.*

Licetus, *De Monstris*, with plenty of plates, shows what can be done in the way of incredible cases.

[e] After many learned examples of women loved by brutes and devils, to which monsters were ascribed, Burton gravely declares, "Many divines stiffly contradict this, but I will conclude with Lipsius, that since examples, testimonies, and confessions of those unhappy women are so manifest in this our town of Lovan, it is likely to be so. One thing I will add, that I suppose in no age past (I know not by what destiny of this unhappy time) have there ever appeared or showed themselves, so many lecherous divels, satyrs, and genii, as in this of ours, as appears by the daily narrations and judicial sentences upon record." (*Anatomy of Melancholy*, 3. 2. 1. 1.)

[f] Mr. Lawrence refers to five examples of this, and some of the subjects were adults, and one lady died at 72 years of age. Sir Astley Cooper's subject had reached old age.

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[g] The poor people very consistently thought he must have a soul as well as Lazarus, and so baptized him. Zacchias disapproves of this, and very reasonably, as the brain showed no intelligence; being compelled to measure mind solely by cerebral power, and, seeing none, to conclude that John Baptist had no soul. Yet though this was reasonable, it was very inconsistent with his belief in soul, since, according to it, John Baptist's case was exactly like that of all idiots: — A soul existed, but merely because the brain—the instrument it had to play upon, was bad, its operation was prevented. Zacchias, who was chief physician at Rome to the ecclesiastical states, extricates himself from the difficulty as cunningly as the Jesuits did when publishing Newton's doctrine as a mere hypothesis. "Latis a summis pontificibus contra telluris motum decretis nos obsequi profitemur," said they. "Ecclesiæ Catholicæ, in hoc et in cæteris omnibus, humiliter me subjicio," says Zacchias. (l. c. vii. 1. 4—17.) The manifestation of mind must determine whether a monster should have the rights of a human being, and its parents those of fruitful spouses. Without some mind, it cannot live at all after separation from the mother, unless attached to another; but should it have no more sense and volition than is sufficient for breathing, it ought not to be destroyed. Two women, one a midwife, were prosecuted at York for drowning a child with deficient cranium that would probably have lived but a few hours or days. The judge expressed a hope that the prosecution would prove the erroneousness of the vulgar opinion that the law allows the life of any human being to be taken away by another. In former times, all monsters were destroyed without ceremony, as the offspring of the devil. Many mothers, among brutes, devour their offspring if it is monstrous, and sometimes even if, on account of having been got by a male of another species, it does not resemble them.

Montaigne saw a boy exactly fourteen years old, who had a headless brother fixed front to front, looking "as if a small child was endeavouring to embrace a bigger." The place of union was below the breasts, and about the extent of four fingers, so that "if you lifted up the imperfect child, you saw the other's navel." (*Essais*, ii. 30.) Winslow saw attached to the body of a well-formed girl, twelve years of age, the abdomen and lower extremities of another smaller than herself. It discharged fæces, and she felt when it was touched. Winslow was consulted upon the propriety of administering extreme unction to it as well as to its sister. (*Mém. de l'Acad. des Sciences*, 1733.) If it had a soul and required

When there is no great difference in the size of the two beings, the case can hardly be styled an excess, or at any rate either party has an equal right to consider the other the exuberance. Such were the Hungarian sisters described by Buffon, who were united at the back below the loins. All the viscera were double; but the recta and vaginæ of both formed one common opening. The aortæ and inferior cavæ also united. They menstruated, evacuated, felt hungry, slept, and were ill at different times, but of course died together.[h] One was rather stronger than the

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baptism, Van Helmont was right in placing the soul in the abdomen. A male pelvis with lower extremities attached to the pubes of a well formed Gentoo boy is described in the *Phil. Trans.* vol. lxxix. The lad had no power over his burthensome piece of a brother, but felt if it was touched. In the medical journals for 1821, is an authentic case of a lad in China, sixteen years of age, named Ake, who had a brother growing to the pit of his stomach, without a head, so that this attached brother seemed as if he had run his head into Ake's body. Whatever part of this was touched, Ake said he felt as if the same in his own body was touched, and really, on the narrator pinching the little one's hip while Ake was looking the other way, Ake instantly turned about and clapped his hand upon his own hip. When Ake made water the little one always did the same. A similar case was more lately published in the second volume of the *Medico-Chirurg. Trans. of Edinburgh*, in which the perfect brother could discharge urine at pleasure from his pendulous brother. Dr. Vulpes (*Istituzioni di Pathologia Generale*, t. i. p. 65.) says that there is, in an anatomical museum at Naples, a healthy fœtus with a mass hanging from its mouth containing the fragments of another. Many other such cases are recorded.

[h] The following epigram, related by Petrarch, was inscribed on stone figures of a similar pair, christened Peter and Paul.

"Non vero nobis unus somnusque cibusque
Nec risus nobis, fletus et unus erat.
Unus membra dabat somno, ridebat et alter,
Surgebatque unus, flens quoque et alter erat."
(F. Petrarch, *De Rer. Mem.* iv. 6. 21.)

Two Italian sisters with one abdomen and one pair of lower extremities, but two chests, necks, heads, and sets of upper extremities, — in fact a double being above the centre of the body, were seen at Paris a few years ago. (*London Med. Gazette*, 1830.) They were christened Ritta and Christina, and I deposited a *white* plaster cast of them in the museum of St. Thomas's Hospital, on which I wrote, nearly from Horace,

—— "Quales neque candididiores
Terra tulit; neque queis *nunc* sit *devinctior ulla*."

other, and dragged her sister with her when they wished to go in contrary directions, and they sometimes quarreled when one only wished to retire; but fortunately Judith and Helen were extremely fond of each other. They attained the age of twenty-one. Most of us have seen the Siamese brothers, united by a band at the sides of their trunk, and equally united in affection, and who are now active and happy young men.

One of the most extraordinary compound monsters is described by M. Maunoir, of Geneva[i], and the subject is preserved in our Hunterian Museum. The two children of which it was composed may be fancied to have been divided transversely, the two upper halves united at the cut part, and the two lower likewise, and then the two compound pieces laid across each other.

The additional being is sometimes not united in this way, but contained in a cyst, and attached to the exterior of the other. A perfect child was born in Devonshire, in 1746, with a tumour attached to the sacrum, containing the rudiments of a fœtus.[k]

The second child, thus encysted, is occasionally placed internally, and may at last cause serious inconvenience. At Genoa, in 1699, a boy, fourteen years of age, had a perfect fœtus taken from his abdomen, through an opening made in a very large tumour just above the umbilicus, that had been increasing from his birth.[l] A girl, five years old, born at Dangerhorst, proved to have in her abdomen all the distinct parts of a fœtus.[m] The Royal Medical and Chirurgical Society has published the case of a boy in whose abdomen was a cyst containing all the parts of a fœtus; and of a girl, two years and a half old, who had a large tumour in the left side, occasioned by a cyst with parts of a fœtus.[n] I recollect that the former case was at first generally disbelieved, and, when believed, regarded as an unheard-of novelty by a large number of the profession. A boy who had reached his fifteenth year in good health was found by Mr. Highmore in Dorsetshire to bear in his abdomen a pretty large imperfect female fœtus.[o] Bartholin relates that a Mrs. Joan, wife of Nicholas Peter, produced a pregnant fœtus.[p] A boy, fourteen years of age, was some years ago discovered after death, at Paris, to have the rudiments of a fœtus in his abdomen[q]; and in the last century one at Tours.[r] A girl at Naumburg became such a kind of a mother in eight days from her birth.[s] M. Velpeau lately removed a tumour from the scrotum of a man 27 years old, which had grown all his life and contained portions of various bones.[t] A male greyhound is said to have voided a live whelp per anum, at Chester, in 1695.[u] A mule is declared to have been produced in Spain with another mule in its abdomen: a cow to have produced a calf in Hungary with another in its abdomen.[x] An egg has sometimes been contained within another.[y]

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[i] *Med. Chir. Trans.* vol. vii.

[k] *Phil. Trans.* vol. xlv. p. 325.

[l] Said to be related in the *Thesaurus Med. Chir. Observat. curios.* Leipsiæ, 1715.

[m] Said to be related in Lieutaud's *Observ. Med.* fasc. i. 1760.

[n] 1809 and 1815.

When an incomplete fœtus is attached to or contained in one that is complete, the case is called parasitic monstrosity. When two perfect children are united, the case is called one of a double child. The frequency of males with parasitic members is to that of females as 34 to 14. The frequency of female double children to that of male is 129 to 40. Fœtuses with the parasitic attached to their surface are males in the proportion of 26 to 6 females; males and females with the parasitic in their interior are in equal proportion. In cases of external attachment by an extreme point, the only example, — junction of the head, occurred in a male; 3 out of 5 instances of junction by the pelvis were females.[z]

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[o] *Case of a Fœtus, &c.* 1815.

[p] *Cent.* vi. hist. x.

[q] Corvisart's *Journal*, t. ix. *Gazette de Santé*, No. 1. 1804. *Saltz. Med. Chirurg. Zeitung*, 1804. 4 b. 290.; all referred to by Plouquet as for three different cases.

[r] *Journ. de Méd.* 1755.

[s] *Dict. des Sciences Méd.* art. *Cas rares.*

[t] *Gazette Médicale.* Paris, Feb. 1840.

[u] *Phil. Trans.* xix. p. 316.

[x] T. Bartholin, *Ephemerid. Nat. Cur.* 1670. dec. 1. an. 1. Moles are there mentioned as containing fœtuses: and Aristotle and Ælian quoted for fœtal mice containing others.

[y] Grew, *Rarities*, p. 18. *Phil. Trans.* xix. p. 632. *Gentleman's Magazine*, xvii. p. 573.

Harvey, *Exerc.* xi. *de Generatione Animal.* p. 86., who showed it to Charles the Second and a large assembly.

T. Bartholin says, "*Ovum prægnans alio ovo hisce diebus anno* 1669 *rusticus mihi ostendit.*" (*Ephemerid. Nat. Curios.* dec. 1. ann. 1670.) In the scholion to this observation are mentioned several instances of a lemon within a lemon (one seen by Harvey), and an instance of an apple within an apple.

Of the same nature as parasitic monstrosity are perhaps certain cases in which hair and sebaceous fat, and frequently teeth, are found collected. The hair has no roots, and occasionally is in immense quantity; the greater part making a compact ball, and the rest immersed in the fat. The teeth are generally molares, and have no fangs. The usual seat of these collections is the ovaria, but then it is the ovaria of virgins. A case lately occurred in which the mass was situated in the anterior mediastinum of a young woman, 21 years of age, and consisted of serous fluid, hair, fat, two cuspidati, two incisores, and three molares, a portion of bone resembling the superior maxillary, and alveolar processes around several of these teeth.[a] Such a mass has been situated in the loins of a gelding; — probably in a testis which had not descended.[b]

The greater number of monstrous formations are discharged prematurely. Autenrieth found 3 abortions monstrous out of 19 whose parts could be distinguished; Wrisberg 2 among 5; and Ruysch 2 in 12: — altogether 7 to 29. Sömmerring counted 7 monstrous out of 29; and, of 47 acephalous fœtuses mentioned by Dr. Tiedemann, 33 came away by miscarriage.[c] Even if there are twins, one perfect and one acephalous, the headless child is almost always born the first, and sometimes a whole day before the other.

The number of female exceeds that of male monsters: but Burdach, who contends that the female is the superior being, urges that this circumstance does not favour the idea of her inferiority, because monstrosities are more common among the superior than the inferior brutes, and in brutes than the human subject.[d]

A sound offspring is frequently born at the same time with a monstrous production, and monstrous productions occasionally alternate with well-formed children. The same observations hold respecting giants and dwarfs; and respecting black or white children of parents of different colours.

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[z] § 216. 1. and 2.

[a] *Med. Chir. Trans.* London, 1825. vol. xiii.

[b] Baillie's *Morbid Anatomy.*

[c] Autenrieth, *Supplementa ad Historiam Embryonis.*

[d] § 215.

Sometimes one unusual formation only occurs in a large family: sometimes several, just as in the case of a dwarf or giant, and perhaps in immediate succession.

Most monstrosities arise from a stage of growth, which naturally is but transitory, not giving place to another, but becoming permanent. Thus fissures are caused by the want of growth towards each other of parts which should at length unite lengthwise. The arrest of growth may be earlier, so that instead of a fissure there is an uncovered cavity. When this is seen in the spinal chord (spina bifida) or brain, the osseous case is generally, but not always, deficient correspondently as well as the skin, so that the only covering is the serous membrane. It is the cause of all degrees of hare-lip. Consequently umbilical hernia is a want of growth of the margin of the umbilical opening: and there is usually no stoppage, but slowness of growth, and nature at length cures the defect. A high degree is when the bladder is seen, and is itself deficient in front. The open state of the foramen ovale or canalis arteriosus is a similar example; or the existence of branchial openings in the neck at birth.

Parts may not open in due time, as when the membrana pupillaris is close at birth, or the meatus auditorius is shut up by a membrane at birth or in adult age; or the rectum or skin over it or both are imperforate. The skin may remain a flat covering to the limbs instead of developing into cylinders.

Portions of organs which should be formed subsequently to other portions sometimes do not grow forth at all, or imperfectly, as when the labyrinth remains alone without cochlea or semicircular canals, or as when the forearm has fingers and no carpus. The limbs may remain disproportionately short or even as mere buds. The skin may remain continuous between the fingers and toes instead of at length opening. The intestine may remain shut and without convolutions.

A part may be absent altogether, either not having been developed beyond a small point and this having been absorbed, or not having existed in the least.

The want of progress in the various parts of the heart give rise to numerous malformations of the organ.

The growth may not proceed so as to change the direction of a part, as when a child is still club-footed after birth. The natural change of position may not take place, as when the testes do not reach the scrotum.

As some parts should grow proportionably small again, their great size may show a defect of growth, as when the appendix vermiformis or the tongue remains very large, or the mouth very wide, or the liver as large after birth as it should be in the last periods of the fœtal state.[e] Arrest of developement may cause a part which should be single to consist of more than one portion, if in one stage of its developement it is made up of distinct portions.

Monstrosity may arise again from excess of developement. An instance of this is when the stomach is divided by a depression into a cardiac and pyloric portion.

An arrest of due change may cause a part to remain in a position which it cannot change; as when the heart remains parallel with the axis of the body.

All monstrosities, however, cannot be explained by some stoppage or excess of the course of developement. Where there is a superabundance, as two heads, there has originally in all probability been an excess, — too much germ, or a fraction of the germ of another child. But the union of two children or of parts of two children, or of one and a part of another, is itself no arrest of developement, but a new circumstance. There may be on the other hand an original defect of germ, so that no developement of an organ shall take place at all.

Proper secretion may not take place: as when the pigmentum nigrum, which should be secreted about the fifth month, does not appear, and an albino is produced. There may be a monstrosity from perversion of developement, — a misdirection, or misplacement, or faulty composition. Anomalies of the origin of blood-vessels, transposition of organs, and texture of parts foreign to them at all stages of developement, are examples of this.

The growth, and all other changes as well as those of form, of any part or portion of parts may be arrested at any period of them, so as to make no further progress.

For a stage to be perfect, the preceding must have been perfect.

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[e] *Dublin Journal*, 1834, April. One unacquainted with the course of developement might injure such a child with the treatment of diseased liver. In some cases the large size may perhaps remain without injury through life, like near-sightedness.

But the perfection of a preceding stage does not insure perfection in the subsequent. Bad tendencies in any organ may be developed, like good ones or changes quite unimportant, at various ages.

It is remarked that malformation more frequently takes place at a late than an early period of fœtal existence, when higher powers of developement are required.

Sometimes proper growth may take place, but too slowly; sometimes too early. Precocious and late puberty are examples of this. Youths, who from want of due changes in the heart's structure were bluish, have lost this hue from the heart having at length grown properly. Growth may proceed too rapidly and go too far; or may proceed too slowly and stop too short.

Different kinds of malformation, excess, defect, &c. may occur in the same individual: and different kinds in different members of the same family: showing a general tendency to malformation.

Blumenbach says that, as the human being passes through so many changes of the brute structure, " human monsters are not unfrequently met with strongly resembling the form of brutes, because the nisus formativus, having been disturbed and obstructed from some cause or other, could not reach the highest point of the human form, but rested at a lower point and produced a bestial shape. On the contrary, I have never found among brutes a true example of monstrosity which, by a bound of the nisus formativus, bore any analogy to the human figure." Certainly, Dr. Fletcher remarks, " a man" " with fewer than five fingers approximates in structure to the Hog, the Sheep, or the Horse, but a Hog with more than four, or a Sheep with more than two, or a Horse with more than one — and such monstrosities are not very uncommon — approximates equally in structure to man."[f]

There are limits to malformation. The lungs are never found in the cranium or the brain in the pelvis. The intestines and aorta never form one canal.

Sometimes the excess of developement of one part is attended by deficient developement of another; as when there is too large a number of fingers on one hand, and too small a number on another. An excess of one part very frequently attends deficient developement of another: — too many fingers often accompanying spina bifida, hare-lip, or imperforate anus. Two bodies have often no head. Supernumerary parts may experience an arrest of developement. Sometimes one child has an excess and another a defect: a girl had 12 fingers and 12 toes, but her sister had a thumb only on one hand.

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[f] *Rudiments*, Pt. i. p. 70.

Internal parts are less subject to excess or defect than external: and parts supplied by encephalo-spinal nerves less subject to malformation of any kind than those supplied by the ganglionic.

Malformation of certain parts generally involves that of others. When the cervical enlargement of the spinal chord does not exist, the upper extremities are always absent.

Parts which should be distinct are sometimes united, merely because the part which separates them is defective: as when the two eyes are but one on account of the absence of the ethmoid bone and of the internal part of the orbit and the existence of the nasal bones above the eyes.[g]

Some monstrosities have arisen from the accidental destruction of a part; as when an early accumulation of serum has compressed a part and thus caused not only its non-developement but its absorption. M. Velpeau has found an arm of a fœtus before the full time just ready to drop off.

Animated beings have a general tendency to produce offspring resembling themselves and progenitors, in form, structure, composition, and all qualities. By this law each animal exists as it is: — a man is a man; a horse is a horse; and an oak is an oak. Not only the species, but the varieties and the minutest peculiarities of the individual in both structure, and composition, and properties are transmitted. Through the most delicate shade of manner, corns, the mode of affection by medicines, and morbid poisons.

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[g] On the subject of malformation, consult Meckel, Sömmerring, Geoffroy St. Hilaire, Serres, Beclard, Tiedemann, &c. The two halves of the body are seldom so well developed as to be perfectly correspondent. The two sides of the head are often different: and jewellers tell me that rings do not equally fit the same finger of each hand, — that the right is generally the larger. Parts of the body that are single and not situated in the centre were originally double and symmetrical, but naturally have been developed more in one portion than another, and have taken a direction from the centre for the purpose of convenience. An aberration in any of these points is a cause of monstrosity.

Most persons are right-handed. No satisfactory reason is given for this; but I presume it depends upon a minute difference of structure in the nervous or muscular system of the two sides. We are as right-footed too, though I never saw this noticed. For I believe that most extra-exertions, as kicking, are executed far better with the right leg than with the left. When people are left-handed, is not this analogous to monstrosity?

> "Fortes creantur fortibus et bonis;
> Est in juvencis, est in equis patrum
> Virtus: nec imbellem feroces
> Progenerant aquilæ columbam."[h]

The offspring of two of the same race may frequently resemble both parents, but the proportion of resemblance to each, both on the whole and in regard to particular parts, is various,—some children favouring the father most, some the mother, though usually resembling each enough to preserve a family likeness, and some resembling one parent almost solely[i],—some parts being as it were an equable compound of the same in both parents, (as the skin in the mulatto offspring of a black and white,) some an unequal compound, (as when the offspring of a black and white is white with patches of black or with merely a black penis[k],) and others again similar to the same as seen in one parent only: and it is remarkable that the resemblance to the parents, whether in regard to common or uncommon peculiarity, is occasionally not observed in the immediate offspring, but re-appears in the third or even a later generation.

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[h] Horace, lib. iv. Od. 4.

[i] Dr. Parsons (*Phil. Trans.* vol. lv.) relates that in Virginia two black slaves of the lady from whom he learnt the fact, married together, and produced a white girl. "When the poor woman was told the child was like the children of white people, she was in great dread of her husband, declaring at the same time, that she never had any thing to do with a white man in her life, and therefore begged that they would keep the place dark, that he might not see it. When he came to ask how she did, he wanted to see the child, and wondered why the room was shut up, as it was not usual. The woman's fears increased when he had it brought into the light; but while he looked at it he seemed highly pleased, returned the child, and behaved with extraordinary tenderness. She imagined he dissembled his resentment till she should be able to go about, and that then he would leave her; but in a few days he said to her, 'You are afraid of me, and therefore keep the room dark, because my child is white; but I love it the better for that; for my own father was a white man, though my grandfather and grandmother were both as black as you and myself; and although we come from the place where no white people were ever seen, yet there was always a white child in every family that belonged to us." The woman did well, and the child was shown about as a curiosity; and was, about the age of fifteen, sold to Admiral Ward, and brought to London in order to be shown to the Royal Society. Dr. Parsons received an account from an eye-witness of a white woman in York marrying a black, and producing a child "entirely black, and in every particular of colour and features resembling the father, without the least participation from the mother." A friend of Mr. White's, named Beazley, met a Negress in a stage with a black and white child, the production of her English husband. (*On the Regular Gradation*, p. 123. sq.)

> "Fit quoque, ut interdum similes existere avorum
> Possint, et referant proavorum sæpe figuras,
> Propterea, quia multa modis primordia multis
> Mista sua celant in corpore sæpe parentes,
> Quæ patribus patres tradunt a stirpe profecta.
> Inde venus varia producit sorte figuras;
> Majorumque refert vultus, vocesque, comasque."[l]

A similar circumstance is that of one sex transmitting certain qualities of its parent of the sex, opposite to its own sex, to its children of that sex. For example, a mother brings forth sons with such modifications of the sexual organs as existed in her father: or a son produces daughters with the sexual peculiarities of his mother. "The property of milking," in the words of an experienced breeder, "is inherited as readily as that of peculiarity of shape." "In the selection of *bulls*, besides attending to those properties which belong to the male, we ought to be careful also, that they are descended from good milkers, at least if we wish the future stock to possess this property."[m]

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[k] *Phil. Trans.* vol. lv.

"A black man servant to a gentleman who lived in the neighbourhood of Gray's Inn, married a white woman who lived in the same family; and when she proved with child took a lodging for her in Gray's Inn Lane. When she was at full time the master had business out of town, and took his man with him, and did not return till ten or twelve days after this woman was delivered of a girl, which was as fair a child to look at as any born of white parents, and her features exactly like the mother. The black at his return was very much disturbed at the appearance of the child, and swore that it was not his; but the nurse who attended the woman soon satisfied him, for she undressed the infant and showed him the right buttock and thigh, which were as black as the father, and reconciled him immediately to both mother and child. I was informed of the fact, and went to the place, where I examined the child and found it was true." (Dr. Parsons.)

A man, the son of a white father and black mother, is said to have kept a public house in Tooley Street, white in his right half and black in his left: a man, the son of a black father and white mother, resident in Prescott Street, Goodman's Fields, and named Clark, to have been black below his navel, and white above: and a girl, born in Somersetshire, in 1759, of a black haired father and carroty mother, to have have had, after she was grown up a little, hair of jet black on the right side of her head, and carroty on the left. (*Zoological Magaz.* vol. xii. p. 369. quoted by White, *On the Regular Gradation*, p. 122.)

Bartholin, *Hist. Anat.*

Schurig, *Spermatologia*, p. 146.

[l] Lucretius, lib. iv. We call this *Atavism;* the Germans, *Rückshlag.*

As the different properties of both parents may be pretty well blended in the offspring, we may sometimes by breeding successively from offspring and one of the original parents, at length produce an offspring exactly resembling this parent. Some dissolute Europeans are said to have begun with a black woman, and copulated with their offspring till they made her the great-grandmother of a white.

National features, form, and in a great measure even character, arise from a nation marrying among themselves, and will be more marked in proportion to the rarity of connection with foreigners. Hence the amazing peculiarity of the Jewish race.[n]

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[m] Mr. Wilkinson, in Mr. Walker's *Intermarriage*, p. 343.

[n] The advantage of crossing breeds is well known, and may be explained by the transmission of the parent's qualities. If any unfavourable deviation in structure or constitution occurs, and is transmitted, and the descendants who receive it hereditarily intermarry, the deviation is doubly enforced in their offspring, whether the effects have manifested themselves in both parents, in one, or in *neither:* but, if a connection is made with another family or breed, it is, on the contrary, diluted. The brain suffers perhaps more than any other organ. The Royal families of Europe, subjected to absurd restrictive rules in their marriages, are a lamentable proof of the ill effects of the marriage of relatives. Imbecility or insanity, in one degree or other, occurs in nearly every Royal family of Europe. It is amusing, when travelling on the Continent, to contrast the wretched legitimate heads on the money with the full front of Napoleon. The rich Jews in this country have the same bad custom of marrying first cousins; and I never saw so many instances of squinting, stammering, peculiarity of manner, imbecility, or insanity, in all their various degrees, intense nervousness, &c. in an equal number of other persons. The custom in Royalty is but one of the many absurdities to which barbarous times have left it still a slave: in the Jews it arises from their never liking to marry a person poorer than themselves, their desire to keep their money in their own families, and from the intensity of all the domestic attachments among this kind-hearted and ill used people, so that cousins are attached before love begins, and this is but a little transition. Could a race, however, have all its wants well supplied and, at the same time, have no unhealthful habit, so as to *acquire* no tendency to unfavourable deviation, and have no latent disposition from old progenitors to any, I do not think that the soundness of breeds would require crosses.

It appears that, when animals of different species or of the same species but of varieties very different from each other, are connected, the offspring is of an intermediate type,—a mule: but, when the animals are of different varieties only and varieties not very dissimilar, the offspring resembles generally one parent only or all but entirely. Thus an Englishman and a Negro woman produce mules,—mulattos; but the half-caste offspring who marry with a white will produce children, some entirely white, some dark like itself. M. Coladon of Geneva made white and brown mice breed together: in every instance the young were purely white or brown. Mr. Jefferson° saw two albino sisters who bore black children to

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The Arabians never allow the mares of the noble race to be covered by any but stallions of their own rank, yet the excellence of the race is maintained. (D'Arvieux, *Travels in Arabia*, p. 168.) Their horses have every comfort, and yet are not subjected, like our domestic animals and most of ourselves, to unnatural habits. Mr. M. N. Smith, who resided long in Arabia, says that the animal degenerates if the in-and-in breeding is very close—incestuous, for three or four generations—and that the Arabs breed them not so closely as this. It might be questioned whether the ill effects of close in-and-in breeding does not depend upon the want of selection which is implied in it:—upon not observing the smallest tendency to imperfection the moment it appears, so as to correct it before it becomes a defect; for the greater the range, the greater of course the possibility of selection. "Animals kept together, as Sir John Sebright remarks, are all subjected to the operation of the same circumstances, and consequently rendered liable to the same diseases; and therefore, for close in-and-in breeding to be safe, the breed should be established in different places, and thus individuals without the same tendencies to disease and degeneration be brought together." (Walker, *Intermarriage*, p. 298. London, 1838; to which work I am indebted for several references.) Certainly, if the same defect occurring in both parents is likely to be entailed on the offspring, the same excellence in both is as likely to be transmitted in great force. Again, a cross may be as injurious as an intermarriage between relations, if the same evil tendency exist in both parties. Still, as few families are without faults of constitution, evident or latent, and these, should they be latent, are likely still to be the same in relatives, family marriages are to be discouraged. Latent evil predisposition exists often in the most healthy looking families, and the chances of coincidence of such disposition is very much less where there is no relationship.

The degeneracy of many plants unless their *soil* is changed, is quite another circumstance; and depends upon the unwholesomeness of the excrementitious matter of every plant to it, whereas this is good nourishment to other plants which succeed to its place in the soil.

° *Notes on Virginia*, p. 119. Dr. Winterbottom also (*Account of the Negroes of Sierra Leone*, vol. ii. p. 170.) mentions a white Negro and black Negress pro-black men: another albiness who bore an albino to a black: and a white negress also a black daughter to a black man. Thus, if an individual has a remarkable peculiarity, such as supernumerary toes or fingers, some one or other of every race of descendants may have it, though they do not intermarry. If the offspring of parents of different families or of sub-varieties only, resembling one parent entirely, marry with another of the same sub-variety, his offspring may more or less resemble his parent,—the grand-offspring the grand-parent. Thus a white sheep produced by a black and white may, by copulating with another white sheep, produce one either black or with black patches. A friend of mine in the East Indies, wishing to have white flocks, bred from white sheep only; but many of these were the offspring of one black parent, and black lambs were continually born of his white sheep. Great and little intellect, good and bad moral qualities, appear in children who in this particular do not resemble either parent, but some other progenitor. I presume that re-appearance of resemblance to progenitors is more likely if both parents are descended from progenitors having the same peculiarity,—that black sheep are more likely to appear among white, if both the white parents had a progenitor more or less black, than if one parent only had a black progenitor.[p]

We do not often know the limit to the number of generations after which a peculiarity may re-appear. But, if, in every instance of its re-appearance, the connection is with another individual destitute of it, probably it will at length cease to appear. In the human race this seldom happens.

If one nation overcome another which is numerous and at a certain degree of civilisation, it cannot extirpate its victims. Hence M. Abel Amusat has been able, by comparing language with history, to discover nearly all the nomadic tribes of Asia in their primitive seats, notwithstanding the numerous revolutions

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ducing two albinos and five blacks; and an albiness, born of black parents, and married to a black, producing blacks.

[p] Though a Jew can generally be recognised, the Jewish features have great diversity; and, from the nation never marrying with others, every peculiarity is little diluted, and the same latent peculiarity will often meet in the individuals who marry. I have consequently been frequently struck with the diversity of Jewish features in Hebrew brothers and sisters, and the diversity from even both parents; all the diversities of Jewish features thus springing up continually.

and conquests in that part of the globe. If the two are in equal numbers and mingle, the characteristics of each will mark their descendants; but will not be blended in every instance, because it is not possible for every pair to be one of each nation. If they are disproportionate, the characteristics of the most numerous will prevail; but the disproportion must be extreme and the two must greatly mingle for the characters of one to be diluted till they are effaced; and if effaced, their disappearance arises probably not from mere mingling, but from the cruel oppression of a very small by a very numerous race till it is extinct. The difficulty of the disappearance of a type will be increased by the probability of each people inhabiting some particular districts and so not mingling. From these circumstances, Dr. Edwards was able to discover the type of the ancient Romans, and probably of the band of the founders of the nation and their surrounding enemies, in the papal territory: and in Tuscany, this, and also another race with a high and well developed forehead, long and not broad head, nose curved till the point drooped, prominent chin, and tall stature, resembling Dante, the busts of the Medici and other distinguished men of the republic of Florence, and traceable in some Etruscan bas-reliefs, and met with by him at Bologna, Ferrara, Padua, Venice, and still more frequently at Milan, as well as on this side of the Alps at Geneva and Chalons. In Burgundy, Dauphiny, and Savoy, another type with rounded head, middling forehead retreating at the temples, straight nose and features, and middling stature, prevailed the most. These two types were the posterity of two Gaulish tribes: the latter the descendants of the ancient Gauls, and the former of the Cimbri. This type he found in England, and therefore infers that the ancient Britons, whose descendants they are, were never exterminated. It exists chiefly in the north of France, the Belgium of Cæsar, and Armorica. In France the Gaul type prevails, and hence the stumpy French soldiers; in Normandy and Belgium the tall men with long faces and noses show the Cimbrian or Kimric type to prevail.[q]

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[q] Dr. W. F. Edwards, *Des Caractères Physiologiques des Races Humaines.* Paris, 1829. For the difference of the intelligence of these families,—the Celtic and Gothic, to which the Cimbrian and Gaulic especially belong, see Dupin's *Forces productives et commerciales de France.* Paris, 1827. In the north-east of France, where the Gothic, German, or Teutonic head prevails, $\frac{1}{14}$ went to school; in the western and interior parts, where the Gaulic or Celtic head prevails,

The tendency to produce like is not so great but that some difference occurs; brothers and sisters are all different. But then they might differ, even were each to have been formed exactly according to the undisturbed force of hereditary transmission; because the proportions of transmission from each parent and from progenitors might be endlessly diversified. Numberless circumstances, however, disturb the operation of the hereditary tendency, too minute in their production of slight varieties for us to appreciate: and the varieties are of infinite degrees and extent. They may be compatible with our views of perfect formation and soundness of health; and not strike us in the least, because a certain amount of variety is ordinary, and we all differ infinitely. Even if rather striking, they still may not be exceedingly unusual or in a very high degree. If the peculiarity, whether it be of obvious structure or of property, interfere with the due performance of function or with health, it is necessarily considered a disease. Thus the congenital want of communication between the kidney and bladder, or a direct communication between the two ventricles of the heart, is an organic disease; the innate tendency to gout, dyspepsia, or phthisis, is a functional disease, though it depend no doubt on a morbid variety of minute composition. The tendency to any disease or shadow of disease may be hereditary.

I must here remark that the tendency to striking deviation may be operative before birth, or at any period after birth. For, just as developement of the truly natural structure and properties takes place at various periods of life, so does that of peculiarities. The cause in some instances may be that a certain stage of natural developement is implied in the peculiarity: for example, just as resemblances to the father in beard or to the mother in the uterine functions cannot occur before puberty, so hereditary diseased conditions of these parts will not occur at an earlier age. But some hereditary tendencies appear to be morbid affections of a particular stage of developement. Hereditary cancer seldom affects the breast before about the 40th year: hereditary cataract most frequently after the 60th. In some instances the period of morbid hereditary tendency is very precise: in others it has a wider range. Hernia takes place spontaneously in different members of some

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only $\frac{1}{143}$ went to school; and in the southern, where the Celtic is mixed, $\frac{1}{44}$ were at school.

families at nearly the same age. Consumption begins in the members of some families at nearly the same age: in those of others, at various ages. Occasionally this difference may arise from exciting causes having strongly operated in the earlier examples. But that this is not always the explanation appears from the visible commencement of hereditary diseases not influenced by external causes. I have been consulted by members of two families in which some of the fingers became permanently bent at a certain time of life. In one the father and four sons had the little finger become bent by the rigid shortening of the tendon: and in all the sons the change took place at 25 years of age. In the other family the right ring finger of the mother and two sons was fixed down in the same way, and the change had begun in the mother at 50; in the second son at 48; in the eldest at 40.

An exception, of more or less amount, to the tendency to produce similar progeny, occasionally occurs. Something disturbs and proves too much for the tendency, and much more frequently, we are told, in the domestic than in the wild state; — the offspring differs in some particular from the parents; but by the force of the general tendency transmits to its offspring its own peculiarity. By selecting such examples, a breed peculiar in colour, figure, the form of some one part, or in some mental quality, may be produced. Thus, by killing all the black individuals which appear among our sheep and breeding from the white only, our flocks are generally white; while, by an opposite practice pursued in some countries, they are generally black: thus a ram, accidentally produced on a farm in Connecticut with elbow-shaped fore-legs and a great shortness and weakness of joint indeed in all four extremities, was selected for propagation, and the ἀγκὼν breed, unable to climb over fences, is now established[r]: thus some breeds of hares have horns like the roebuck: the Dorking fowl has two hind claws; and fowls in short are bred in every conceivable variety.[s] The Imperial family of Austria is remarkable for its thick upper lip, which is believed to have been introduced into it centuries ago by a cross with the ancient house of Jagellon.[t]

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[r] Sometimes a peculiarity is transmitted to the offspring of one sex only. Thus the peculiarity of the skin of the Porcupine family is restricted to the males. (*Suprà*, p. 270.) In a family at Iver, for nine generations there were no fingers except first phalanges, and a first and second joint to the ring finger as well as the phalanx, but without a nail; and the women only transmitted this defect to their offspring. (*Ed. Med. and Surg. Journ.* vol. iv.)

Where the organs are different in the two sexes, as the genitals, the peculiarity shows itself in the corresponding parts. Thus the enormous nymphæ of some African tribes have a counterpart in the enormous prepuce of the male,— "the old reproach of Egypt."

In some tribes of plants and races of animals, varieties continually spring up and cease to be transmitted. In others they are rarer and are transmitted permanently.

A QUESTION here presents itself.—Are the differences among mankind to be ascribed to the influence of various causes upon the descendants of two,—or of more, but all similar, primary parents;—or to original differences in more than two primary parents?

This, being a physical subject, is now always physically investigated, without reference to the Bible, except as an historical work, in conformity both with the opinion of Locke, that only matters above human reason are the proper subjects of revelation; and of Bacon, that religious and philosophical inquiry should be kept separate, and not pompously united.[u] A true revelation cannot suffer by the progress of philosophy; but philosophy has seriously suffered by ignorant appeals to Scripture. Besides, many will not listen to arguments from Scripture in matters of philosophy, alleging the want of proof of inspiration, or of unquestionable meaning. Dr. Bostock, one of the most careful and amiable of inquirers, does not hesitate to say, that "we do not find that the writer of the Book of Genesis lays claim to any supernatural source of information with respect to natural phænomena, while the whole tenor of his work seems to show, that on such topics he adopted the opinions which were current among his contemporaries."[x] Professor Rudolphi of the University of Berlin writes of the Mosaic account "as a very improbable Jewish tradition."[y]

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[s] Thomson's *Annals of Philosophy*, No. 2.

[t] Coxe's *Memoirs of the House of Austria.*

[u] See *suprà*, p. 72. 75. sq.

Many distinguished scientific living characters utter the same sentiments in private conversation. Some of them quote Bacon, who calls nature "*quasi altera revelatio*;" and Young, who says,

> "'T is elder Scripture writ by God's own hand,
> Scripture authentic, incorrupt by man.
> (*Night Thoughts*, ix.)

Some refer us to Dr. Strauss's *Leben Jesu* and Mr. Hennel's *View of the Origin of Christianity* for the reasonableness of their total infidelity. Some argue that, though believing, they have a right to consider passages as mere fabrications introduced by knavery or folly, if absurd, just as the passage in St. John's first Epistle, "There are those that bear witness," &c. is now rejected by many sound divines, though read regularly in our church service and believed by all who are Christians from mere imitation. Some argue that, though a passage be authentic, every one has a right to interpret it in his own way; just as great divines contend that the periods called days in the Mosaic account of the creation need not be understood as days, in the face of the reason given in Exodus by Moses in God's name for resting from work on the seventh *day*,—because God, having worked six days, rested on the seventh "and was *refreshed*," (xxxi. 17.) though it is difficult to suppose any other than the ordinary meaning of the word day when used in this argument.

In favour of the opinion that we are all brothers, it may be urged, — 1. The universal simplicity of nature's causes would induce us to imagine that, as, if the varieties among us are accidental, two individuals were evidently sufficient for the production of the rest of mankind, no more than two were originally created. Nor should I deduce a contrary presumptive argument from the length of time during which immense portions of the earth must have thus remained unpeopled. One of nature's objects seems the existence of as much successive life as possible, whether animal or vegetable, throughout the globe. For this purpose,

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Just as, also, in the face of the simple, clear, and positive words of the fourth commandment, "Thou shalt do no manner of work, thy man-servant, nor thy maid-servant, nor thy cattle," the most intolerant religious persons plainly think the commandment not worth notice, for they drive to church on Sundays with horses and men-servants to declare to God their reverence of him and their wish to obey every letter of his holy word, and actually to see the fourth commandment on the walls at the altar and hear it read, and at the end of hearing it read they exclaim, "Lord have mercy upon us, and incline our hearts to keep *this* law,"—that is to say — the law of the Jewish Sabbath. Again, in spite of this part of the church service, some of its ministers contend that the Jewish Sabbath is no longer a divine ordinance. While all this passes, philosophers have a right to believe that mankind are descended from one pair or more as they see fit, without any imputation of sin. Some argue against no part of Scripture, but at once contend that its purpose is solely to make men pious to God and good to man, just as Paley declares that the doctrine of the atonement would never have been revealed but for a moral purpose; (*Sermon on Seriousness of Heart as to Religion.*) and they therefore invariably refuse to consider in writing or conversation any other than points of practice, and study the *works* of Creation independently. (See *suprà*, p. 46. sq.)

[x] *An Elementary System of Physiology*, vol. iii. p. 286.

[y] *Grundriss der Physiologie.*

every species of animal and vegetable possesses an unlimited power of propagation, capable of filling the whole world, were opportunity afforded it. The opportunities of exertion are indeed very scanty, compared with the power: climate, soil, situation, may be unfavourable; one vegetable, one animal, stands in the way of another; even the impediments to the increase of some, act through them as impediments to others. The incessant tendency of the power of multiplication to exert itself seizes every opportunity the moment it is presented, and thus, though every living object has a fixed term of existence, and may be carried off much earlier by innumerable circumstances, all nature constantly teems with life.[z] The slow increase of mankind could not interfere with this apparent object of nature; the deficiency of our race must have invariably been fully compensated by the opportunities which it afforded for the multiplication of other existences: for that proud man alone was not designed to enjoy the earth, and that he is but an item in animated nature, is shown by the vast tracts of unpeopled land, and the vast number of situations inhabitable by other animals only.

Individuals, distinguished from others by no greater differences than those which spring up accidentally, cannot be supposed to belong to a separate species. Upon the comparison of these differences depends the *analogical argument* first employed by

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[z] From this physiological fact it follows that, if a species is not kept down by disease or violence, or, as should be the case with mankind, by good feeling, to such numbers as can find support, the excess must regularly perish. To vegetables this can be no cruelty. As all the brute creation are preyed upon, their numbers may be generally sufficiently thinned without starvation. Violent deaths are too insignificant to operate much in restraining the numbers of mankind, and terrible as is the havoc of disease, the rapid increase of those nations who can command any extent of land they require for food, proves *it* not to be the great restrainer of population while food and fresh air are enjoyed. Starvation, however, is not necessary to limit our numbers, because it is the imperious duty of every man to abstain from getting children unless he has property or work sufficient to feed them when they come into the world.

These palpable facts have been luminously stated by a celebrated member of my own College at Cambridge; and how any one can deny them, or pretend there is impiety in Mr. Malthus's *Essay on Population,* I cannot comprehend. Mr. Mills (*Supp. to Encyclop. Brit.* art. *Savings Banks*), considers that the addition made by Mr. Malthus to the admitted doctrine of population being commensurate with food is that man's tendency to marry and prolific powers cause a greater number to be born than can be fed.

Blumenbach. Finding the ferret (*Mustela furo*) to differ from the polecat (*M. putorius*) by the redness of its eyes, he concludes it is merely a variety of the same species, because instances of this deviation are known to occur accidentally in other animals; but he concludes the African elephant is of a species distinct from the Asiatic, because the invariable difference of their molar teeth is of a description which naturalists have never found accidental. Now there exist among mankind, he contends, no differences greater than what happen occasionally in separate species of brutes.

The colours of the animals around us, horses, cows, dogs, cats, rabbits, fowls, are extremely various,—black, white, brown, grey, variegated.

The hair of the wild Siberian sheep is close in summer, but rough and curled in winter[a]; sheep in Thibet are covered with the finest wool, in Ethiopia with coarse stiff hair[b]; the bristles of the hog in Normandy are too soft for the manufacture of brushes[c]; goats, rabbits, and cats of Angouri, in Anatolia, have very long hair, white as snow and soft as silk.[d]

The head of the domestic pig differs as much from that of the wild animal, as the Negro from the European in this respect[e]; so the head of the Neapolitan horse, denominated ram's head on account of its shape, from that of the Hungarian animal, remarkable for its shortness and the extent of its lower jaw[f]; the cranium of fowls at Padua is dilated like a shell, and perforated by an immense number of small holes[g]; cattle and sheep in some parts of our own country have horns, in others not; in Sicily sheep have enormous horns[h]; and in some instances this animal has so many, as to have acquired the epithet polyceratous.

The form of other parts is no less various. In Normandy, pigs have hind legs much longer than the fore[i]; at the Cape of Good Hope, cows have much shorter legs than in England[k]; the difference between the Arabian, Syrian, and German horses is sufficiently known; the hoofs of the pig may be undivided, bisulcous, or trisulcous.

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[a] Pallas, *Spicileg. Zoologica.*

Dr. Prichard has seen a boy near Somerton, the son of ordinarily looking English rustics, with hair as woolly as that of any Negro, undistinguishable from it except in colour and a little more glossiness. (l. c. vol. i. p. 363.)

[b] Blumenbach, l. c. § 28.

[c] l. c. [d] l. c. [e] l. c. [f] l. c.

[g] Pallas, *Spic. Zool.* fasc. iv. p. 22. Sandifort, *Museum Anatomicum Acad.* Lugd. Batav. t. i. p. 306.

[h] Blumenbach, l. c. § 30. [i] l. c. [k] l. c.

These are regarded by naturalists as but accidental varieties, yet they equal or surpass the varieties existing among mankind. Blumenbach consequently is led by analogy to conclude that the differences of nations are not original but acquired, and impose no necessity for believing that more than one stock was at first created.

Direct facts are said to harmonise with this conclusion. All races run insensibly one into another, and therefore innumerable intermediate examples occur where the distinction between two varieties is lost. Again, no peculiarity exists in any variety which does not show itself occasionally in another. Many instances of these facts have been already related (page 1067. note[p]). The difficulty of regarding the Negro as of the same stock with ourselves vanishes on viewing these circumstances, and on reflecting that he and ourselves are two extremes, one of which may have sprung from the other by means of several intermediate deviations, although experience may not justify us in supposing any single deviation of sufficient magnitude.[1] An accidental deviation in the early ages of mankind would give origin to a nation peculiarly characterised. Lastly, both the males and females of all the varieties breed together readily and in perpetuity[m],—an assertion which cannot be made in regard to any different species of brutes; but this shows only that all are of one species, not that the different races have a common origin.[n]

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[1] In regard to colour, however, the Albino proves how great a change may take place in one generation. In the *Memoirs of the London Medical Society*, (vol. iii.) is described a case, where not only patches of the hair of the head of an European changed from black to perfect white, first on one side and then on the other, and in the course of seven years every hair became white excepting the eyebrows, but the skin also from being swarthy became fair. (I may add that the irides remained unchanged, and that another case is annexed to it in which half the hair was black and lank, and the other half light and frizzled.) I recollect accounts of other persons, who belonged to the dark races, turning white,—one of a Negress, in Maryland, 40 years of age, who had been turning white during the last fifteen years, and had become scarcely inferior in any part of her surface to an European, and was still changing, (*Phil. Trans.* vol. li.),—one in the *Manchester Memoirs* (vol. v. Pt. 1.), of a Negro about 40 years of age, whose skin had so changed in two years that the narrator was convinced that all the black portions remaining did not exceed a square foot, and the change still continued to proceed very rapidly,—one of a man, born in Bengal, near 60 years of age, who left India in his 10th year, and had for nine years been changing to white, (Dr. Duncan, jun. *Reports in the Practice of the Clinical Ward of the Royal Infirmary of Edinburgh*, p. 138.),—one mentioned by the Duc de Rochefoucault Liancourt. (*Travels through the United States*, vol. v. p. 124. sqq.) The Duke says that the change which had been proceeding for three years, was still going on,

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that the wool of the head had changed to European hair, and that several such instances, though less complete, had occurred. Another will be seen in the *Journal of the Royal Institution*, No. xii. p. 379. Sömmerring (*Ueber die Körplicher Verschiedenheit des Negers von Europaer.* 1785.) quotes Klinkosch (*De vera Natura Cuticulæ.* Prag. 1775. § 25.) for the fact of a Negro becoming yellow.

Caldani (*Inst. Physiol. et Pathol.* p. 170. cap. xvi. § 231.[a]) declares that a Negro shoemaker at Venice grew so light that he resembled a person slightly jaundiced.

Bomare mentions a French peasant whose abdomen became entirely black in every pregnancy.

Camper gives an account of a female of rank, who had a beautiful complexion and white skin, except when pregnant, and then she immediately grew brown,—"vers la fin de la grossesse elle dévenoit une véritable Négresse:" and he says of another that, when she was pregnant, her left leg became black, and after delivery gradually recovered its natural white. (*Kleine Schriften*, 1 b. s. 47.)

A Sussex girl was, a few years ago, a patient in St. Thomas's Hospital, whose family were all white, but whose left shoulder, arm, and hand, were of Negro blackness, except that a stripe of white ran between the elbow and arm-pit. (Dr. Wells's *Works.*) I once saw a young Welsh woman whose left upper arm was remarkably dark. The shoulder was almost as black as a Negro's, but the colour became gradually lighter down the arm, and abruptly terminated an inch below the elbow. The greater part of the upper arm was covered with fine scanty hairs. Blumenbach possessed skin of Negro blackness taken from the abdomen of a white beggar. A white woman in twenty years became as black as a Negress, without any evident reason, according to a statement in the *London Medical and Physical Journal* (1811, p. 24.),—another suddenly became black from mental distress, and remained so; and the blackness was not from jaundice, congestion of blood, &c., but a change in the colouring matter of the rete mucosum. (*Journal Général*, vol. lxviii., where a second is referred to.) Sömmerring cites one from Dr. Strack, in which the blackness succeeded ague. (*De Febrib. Intermit.* p. 194.) And other such cases may perhaps be discovered, though those which I have read appear to have been instances of cutaneous disease.

[m] Examples have already been mentioned (p. 781. sq.) of what is a still stronger argument,—the *simultaneous* production of two individuals of different varieties,—of a Negro and a Caucasian, by the same mother.

[n] Mules or the offspring of individuals of different species, whether vegetable or animal, generally do not breed at all; if they breed, it is almost always with individuals of one of the parent species, not with each other; and if they breed

Others, as Dr. Morton, contend that, although all mankind must be of one species, each of the above varieties, or races as he would rather denominate them, was of separate origin and "adapted from the beginning (by an all-wise Providence) to its peculiar local destination." In other words, that the physical characteristics which distinguish the different races are independent of external causes. Dr. Caldwell argues that "It is 4179 years since Noah and his family came out of the ark. They are believed to have been of the Caucasian race:" "3445 years ago a nation of Ethiopians is known to have existed. Their skins, of course, were dark, and they differed widely from the Caucasians in many other particulars. They migrated from a remote country and took up their residence in the neighbourhood of Egypt." Supposing that people to have been of the stock of Noah, the change must have been completed and a new race formed in 733 years, and probably in a much shorter period.

Dr. Morton contends that it is but 4179 years since Noah and his family came out of the ark; and they were Caucasians. A nation of Ethiopia is known to have existed 3445 years ago, black and differing from the Caucasians in many other particulars. They emigrated from a remote country and took up their residence in the neighbourhood of Egypt. If they were of the stock of Noah, the change must have been completed and a new race formed in 733 years, and probably in a much shorter period. Belzoni's discoveries of paintings executed on the walls of Egyptian tombs above 3000 years ago prove the Caucasian and Ethiopian races to have been characterised precisely as at present; so

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with each other, so that the parent race is soon re-established, sometimes at once, this is in the case of vegetables only, and never beyond the third generation.

Nature seems to oppose the production of hybrids. Decandolle asserts that forty instances only are found in the wild state of plants: many of these are proved to be sterile, and the fertility of the rest has not been ascertained. Hybridism is doubtful among insects; rare in fishes; more frequent among birds; and very numerous in the mammalia, but usually, though not always, effected by art. Unless in cases of seclusion from individuals of their own kind, brutes seldom unite with other species; and great difficulty is experienced under most circumstances to bring them together. (Burdach, § 617.) When they mix with another species the connection is generally unprolific; if prolific, generally abortion destroys it: if the offspring survives, still it is generally unprolific; and if prolific, is fruitful with individuals of one of the parental species. See Dr. Prichard, l. c. vol. i. 138. sqq.

that, resting upon this fact, we may maintain that if the Caucasian race were derived from the Ethiopian, or the Ethiopian from the Caucasian, by external causes, the change must have been effected in at most 1000 years:—an idea which the subsequent experience of thirty centuries proves to be a physical impossibility.

Dr. Prichard allows that, since he first wrote on the opposite side, Virey, Desmoulins, Bory de St. Vincent and others have asserted in the most positive manner, in their writings, an original diversity of the races of mankind: that Cuvier admitted this conclusion; and that the most celebrated travellers have been impressed with a similar persuasion.

Those who oppose the opinion of our descent from two parents, urge that the five hundred millions of human beings that may at present exist, could not have descended from one pair without a chain of wonders; that accidents, diseases, &c., might have happened to our first parents, and the peopling of the earth would thus have been left to chance; that no reason can be given for mankind wishing to leave their place of birth and traverse continents and oceans,—that indeed mankind is generally indisposed to migration; and that the supposition is supported by no other authority than "a very improbable Jewish tradition."[o]

The cause of the differences of our species has been more or less sought for in climate, alone or in conjunction with other external circumstances, by Aristotle, Hippocrates, Cicero, Pliny, Plutarch, Galen, nearly all the Greek and Roman historians and poets, Montaigne, Montesquieu, Buffon, Zimmermann, Blumenbach, Dr. Smith of America, &c. Lord Kaimes denied the power of these circumstances to produce the diversities of either mind or body; and Hume expressly wrote an essay to prove the insufficiency of climate with respect to the varieties of national character. Now the intensity of light unquestionably affects the colour of the surface, although not to the degree of Ethiopian blackness; heat the texture and growth of the hair[p]; light or heat the colour of feathers[q], and quantity of nourishment the size.

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[o] Dr. Rudolphi, professor in the University of Berlin. *Grundriss der Physiologie.*

[p] The present sheep of the West India Islands, though descended from the woolly sheep of Europe, are covered with coarse hair.

[q] I brought from St. Gothard, in Switzerland, a winter specimen of the Lagopus alpinus perfectly white; a summer specimen, brown; and a spring

By starvation plants are dwarfed; the Dahlia has diminished from 6 feet to 2: the Spruce fir from a lofty timber tree to a pigmy bush; and many of the trees of the plains become more and more dwarf as we ascend the mountains, till at length they exist as mere underwood. The size of Mollusca differ so much, according to external circumstances, that, as Mr. Gray mentions, the *Bulimus rosaceus* on the mountains of Chili has been described as a species distinct from that on the coast: and the *Littorina petræa* in the south side of Plymouth breakwater acquires from its great exposure to light and heat twice the size of the individuals on the north side of the harbour.[r] But the effects of these circumstances are generally considered superficial on the higher brutes, though necessarily less protected against their influence than man.

The vegetable system and the lowest or most vegetable-like animal systems are greatly affected by external circumstances. German writers find that the fungi produced by a decomposing infusion depend as much upon the influence of the material employed as upon the germ which is influenced: and lichens are of

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specimen, partly white and partly brown. The fact of the influence of season on the colour is well known in regard to other animals also. The difference of the hair of the Siberian sheep in summer and winter I have already mentioned at p.1107. The difference of the coats of animals is proportionate to the difference of the temperature at various seasons. In hot climates the coat never alters; and in cold climates it alters more than in the mild. The winter coat of horses is scarcely different from that of summer in Germany, but consists of long hairs in Norway. The longer the winter, the greater the duration of the winter coat. In the Lepus variabilis it lasts 6 or 7 months in Switzerland, 8 or 9 in Norway, 10 in Lapland, and all the year in Greenland. A lemming kept its summer brown coat as long as it was in Capt. Ross's cabin, but became white in 8 days on deck. However, both the Lepus variabilis and Lagopus alpinus have their winter and summer coat before the seasons quite arrive, the former in October and the latter coat in March; just as Kirby and Spence found hybernating insects grow torpid at the appointed period though the weather be warm, and not before it though the weather be prematurely cold. (*Suprà,* p. 628.) Nature seems to have prepared a disposition conformable to the circumstances in which she intended animals to be placed, and yet allows them to be influenced by circumstances; and in some the force of disposition, in others the force of external agency, has the greater influence.

[r] *Phil. Trans.* 1833. See Mr. Carpenter's *Principles of General and Comparative Physiology,* § 517., — a work which makes me proud to think he was once my pupil, although he can have been but little indebted to me.

various appearances according to the circumstances in which they are developed. (See *suprà*, p. 717.) A mucor, one of the inferior fungi, constituting mould, is declared by Mr. Berkely to have developed itself as a conferva and been recognised afterwards by its fructification.[s] Nay, we read that the special reproductive particles formed in the shields of the higher species are capable of developing themselves into the same specific forms; while the powdery matter of their surface, and of other individual parts of their structure, may separately exist in the condition of inferior species[t]: so that in these lower systems we may readily conceive the weakness of the tendency to the production of likeness to the parent.[u] External circumstances so influence variety in the higher plants, that many which are now known to be varieties of the same species were formerly regarded as of different species: and no wonder, since one Orchideous plant has produced the flowers and pseudo-bulbs of three distinct genera.[x]

The skulls of foxes belonging to northern regions are not different from those of France or Egypt: the tusks of the elephant, and the horns of the stag and reindeer, may acquire a larger size when the food is more favourable to the production of ivory or horn, but the number and articulations of the bones, and the structure of the teeth, remain unaltered.[y] So, while the colour of flowers is greatly altered by soil and climate, the spots on the wings of moths and butterflies are never known to vary.

Nor are these changes, any more than those induced by mechanical means, as pressure, division, &c., transmitted to the offspring. The flat headed Indians of Ormuz are known to compress their skulls; but Dr. Morton considers it certain that the forms thus acquired "never become congenital even in successive generations, but that the characteristic form is always preserved, unless art has directly interfered to distort it. The child of the most sun-burnt rustic is born equally fair with other children; even all the children among the Moors are born white and acquire the brown cast of their fathers only if exposed to the sun[z]; although the Jews have most religiously practised the right of circumcision from the days of Abraham, their foreskin still remains to be circumcised.[a] Were it therefore true that all dark nations are the inhabitants of hot climates, as the confined knowledge of the ancients led them to believe, it would still be untrue that the change effected, for instance, in the colour of the parent's skin, had descended to the offspring. But modern discovery has made us acquainted with light nations inhabiting the warmest regions, with dark nations inhabiting the coldest, and with others of various shades of colour although in the same climate.[b] Many protected parts are as black as those which are exposed. Nor are the varieties of mankind more dependent upon the varieties of food.

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[s] *Magaz. of Zool. and Anatomy*, vol. ii. p. 340.

[t] Dr. Lindley's *Natural System of Botany*, p. 331. sq.

[u] This fact is thought to throw light upon the production of parasitic plants and animals in others, especially when we reflect that they are found in embryos and eggs. See Mr. Carpenter, l. c.

[x] *Linnæan Trans.* vol. xvii.

[y] Cuvier, *Discours Préliminaire aux Recherches sur les Ossemens Fossiles des Quadrupèdes. Natural varieties* only are meant. Local situation can produce the most intimate structural *diseases;* witness Cretinism.

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[z] Poiret, *Voyage en Barbarie*, t. i. p. 31. Vide Blumenbach, l. c.

[a] Paley, *Natural Theology*, c. 23. p. 472.

This striking fact proves, I think, that accounts of accidental mutilations of parents being followed by offspring similar in that particular are, some untrue, and others explicable by the effect on the mother's mind. For that the state of this will influence offspring I shall presently show. Burdach says that mastiffs and setters with cropped tails often produce pups with cropped tails; and that this connate mutilation is common in Kamtschatka, where it is the custom to dock the tails of drawing dogs; that Blumenbach mentions a man, whose right little finger was once partly separated and replaced awry, and who had several children born with the same deformity on their right little finger; that a woman, one of whose fingers was left deformed by a whitlow, gave birth to two children with the same deformity; and that according to a writer in Meckel's *Archives*, a man whose right iris was nearly motionless and marked by a brown spot in consequence of an accident in his infancy, transmitted this deformity completely to his eldest child, partly to those which first followed, and not at all to the three born the last. Now in all these cases the deformity has been visible and striking: the penis of the Jew is not seen by the female, or if ever it is seen, the absence of the prepuce cannot strike her, and no Jew is born without a prepuce. I must, therefore, ascribe Burdach's instances to the impression on the mother's mind.

[b] Lord Kaimes, M. de Virey, and Dr. Prichard, have quoted many instances of these facts. "We found," says Humboldt, "the people of the Rio Negro swarthier than those of the lower Orinoco, and yet the banks of the first of these rivers enjoy a much cooler climate than the more northern regions. In the forests of Guiana, especially near the sources of the Orinoco, are several tribes of a whitish complexion, the Guiacas, Guajaribs and Arigues, of whom several robust individuals exhibiting no symptom of the asthenical malady which characterises Albinos, have the appearance of true Mestizos. Yet these tribes have never mingled with Europeans, and are surrounded with other tribes of a dark brown hue. The Indians, in the torrid zone, who inhabit the most elevated plains

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of the Cordilleras of the Andes, and those who are under the 45th degree of South latitude, have as coppery a complexion as those who under a burning climate cultivate bananos in the narrowest and deep valleys of the Equinoctial region. We must add that the Indians of the mountains are clothed, and were so long before the conquest, while the aborigines, who wander over the plains, go quite naked, and are consequently always exposed to the perpendicular rays of the sun. I could never observe that in the same individuals those parts of the body which were covered were less dark than those in contact with a warm and humid air. We every where perceive that the colour of the American depends very little on the local position in which we see him. The Mexicans, as we have already observed, are more swarthy than the Indians of Quito and New Granada, who inhabit a climate completely analogous, and we even see that the tribes dispersed to the north of the Rio Gila are less brown than those in the neighbourhood of the kingdom of Guatimala. This deep colour continues to the coast nearest to Asia, but under the 54° 10′ of North latitude, at Cloak Bay, in the midst of copper-coloured Indians, with small long eyes, there is a tribe with large eyes, European features, and skin less dark than that of our peasantry." (*Political Essay on New Spain*, translated.)

The Jews settled in the neighbourhood of Cochin "are divided into two classes, called the Jerusalem or white Jews, and the ancient or black Jews."—"The white Jews look upon the black Jews as an inferior race, and not as a pure caste, which plainly demonstrates that they do not spring from a common stock in India." (Buchanan, *Christian Researches in Asia*, p. 219. &c.)

The white appear to have resided there upwards of seventeen hundred years.

Dr. Shaw and Mr. Bruce describe a race of fair people in the neighbourhood of Mount Aurasius, in Africa, who, "if not so fair as the English, are of a shade lighter than that of any inhabitants to the southward of Britain. Their hair also was red, and their eyes blue." They are imagined to be descendants of the Vandals. (Bruce, *Travels.*)

The Samoiedes, Greenlanders, Laplanders, Esquimaux, &c. are very swarthy; nay, some of the Greenlanders are said to be as black as Africans.

"Do we not in fact behold," says M. de Virey, "the tawny Hungarian, dwelling for ages under the same parallel and in the same country with the whitest nations of Europe; and the red Peruvian, the brown Malay, the nearly white Abyssinian, in the very zones which the blackest people in the universe inhabit? The natives of Van Diemen's Land are black, while Europeans of the corresponding northern latitude are white, and the Malabars in the most burning climate are no browner than the Siberians. The Dutch, who have resided more than two centuries at the Cape of Good Hope, have not acquired the sooty colour of the native Hottentots; the Guebres and Parsees, marrying only among them-

It is not probable that the ardour of the procreants affects the energy of the offspring. But from the days of Aristotle it has been remarked that bastards are frequently endowed with great genius and valour, and both ancient and modern history certainly affords many such examples; and the circumstance has been commonly ascribed to the impetuosity of the parents during their embraces. Shakspeare, in King Lear, introduces Edmund bursting into this indignant soliloquy:—

> "Why bastard? wherefore base?
> When my dimensions are as well compact,
> My mind as generous, and my shape as true,
> As honest madam's issue? Why brand they us
> With base? with baseness? bastardy? base? base?
> Who in the lusty stealth of nature take
> More composition and fierce quality
> Than doth, within a dull, stale, tired bed
> Go to the creating a whole tribe of fops
> Got 'tween sleep and wake?" Act i. scene 2.

"Hercules, Romulus, Alexander (by Olympia's confession), Themistocles, Jugurtha, King Arthur, William the Conqueror, Homer, Demosthenes, P. Lumbard, P. Comestor, Bartholus, Adrian the fourth Pope, &c. were bastards; and in almost every kingdom the most ancient families have been at first princes' bastards; the worthiest captains, best wits, greatest scholars,

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selves, remain white in the midst of the olive-coloured Hindus." (J. T. Virey, *Histoire Naturelle du Genre Humain*, t. i. p. 124.)

The tribes which wander along the burning plains of the Equinoctial region of America have no darker skins than the mountaineers of the temperate zone. "Again, the Puelchés, and other inhabitants of the Magellanic region, beyond the 55th degree of S. latitude, are absolutely darker than the Abipones, Mecobios, and Tobas, who are many degrees nearer the equator. While the Botocudys are of a clear brown colour, and sometimes nearly white, at no great distance from the tropic; and moreover while the Guyacas, under the line, are characterised by a fair complexion, the Charruas, who are almost black, inhabit the 50th degree of S. latitude; and the yet blacker Californians are 25 degrees north of the equator." "After all, these differences in complexion are extremely partial, forming mere exceptions to the primitive and national tint that characterises these people from Cape Horn to the Canadas. The cause of these anomalies is not readily explained. That it is not climate is sufficiently obvious, and whether it arises from partial emigration from other countries, remains yet to be decided." (Dr. Morton.)

bravest spirits in all our annals, have been base. Cardan, in his Subtleties, gives a reason, &c.—Corpore sunt et animo fortiores spurii, plerumque ob amoris vehementiam," &c.[c]

Were this explanation satisfactory, the first fruits of wedded love would still generally be on an equality with illegitimate offspring. If a greater proportion of illegitimate than of legitimate persons have really rendered themselves illustrious, their superior energy may be attributed to the strength of their parents' constitutions, it not being likely that the weak and delicate so frequently become the prey of unlawful passions as the vigorous, and to the necessity in which such individuals usually find themselves to rely upon their own exertions. Their native excellence was at least not acknowledged by Moses. "A bastard shall not enter into the congregation of the Lord; even to his tenth generation shall he not enter into the congregation of the Lord."[d]

The health and strength of both the parents must have powerful influence. But some think that the state of the mind of the parents during the deed of kind is highly important. Aristotle ascribes monstrosity to the circumstance of the parents being careless and thinking of something else during the transaction. In Switzerland and other places, I have heard the peasants ascribe the idiotism of cretins whom I met to one or both of the parents being drunk. If the state of the mother's mind during pregnancy will affect the child, we cannot doubt that its condition at the moment of impregnation will have the same influence: nor is it unlikely that the father's mental condition at the moment will affect it.

Many people are satisfied that mental impressions made upon the mother may affect the offspring. Others, as Mr. Lawrence[e], consider it needless to pursue "a question on which all rational persons well acquainted with the circumstances are already unanimous." "This belief," continues he, "in the power of imagination, like the belief in witchcraft, is greater or less according to the progress of knowledge, which in truth differs greatly in different countries and heads. We know that many enlightened women are fully convinced of its absurdity, while *soi-disant* philosophers are found to support it."[f] So many extraordinary coincidences, however, both in the human and the brute subject, have come to my knowledge, that I do not hesitate to believe the common opinion to be well founded; and, since I declared in my edition of 1820 my inclination to support the opinion, I find it has many supporters.[g] That neither all nor most malformations can be thus explained; that pregnant women are frequently alarmed without such consequences, even when most dreaded, and that highly ridiculous resemblances are fancied to preceding longings and alarms which were forgotten or may be well suspected to have never existed, is incontestable. But, in other matters, when a circumstance may proceed from many causes, we do not universally reject any one because it is frequently alleged without reason. A diarrhœa will arise from ingesta wrong in quality or quantity, from cold, cathartic substances, and also from emotion; and yet emotion has every day no such effect. The notion is of great antiquity, as it prevailed in the time of Jacob. How those who believe the Divine authority of the Bible can reconcile the

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[c] Burton, *Anatomy of Melancholy*, vol. ii. p. 16. sq.

Vanini exclaims, " O utinam extra legitimum et connubialem thorum essem procreatus! Ita enim progenitores mei in venerem incaluissent ardentius, accumulatim affatimque generosa semina contulissent, e quibus ego formæ blanditiam et elegantiam, robustas corporis vires, mentemque innubilem, consequutus fuissem. At quia conjugatorum sum suboles, his orbatus sum bonis." (*De Admirandis Naturæ.* Parisiis, 1616.)

[d] *Deuteronomy*, xxiii. 2.

[e] *Med. Chir. Trans.* vol. xiv. p. 206. 1814.

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[f] "We may perhaps be excused," says Dr. Fletcher, "from at once chiming in with the accustomed cant that the emotions of the mother '*cannot possibly*' have any effect on its organism. We '*cannot possibly*' explain perhaps what is the immediate process by which such vitiated secretions have this effect, nor shall we be able to do so, till we know a little more of the *vis plastica* than its numerous appellations; but neither shall we be able, till then, to explain why this effect should be impossible. It is much easier in these matters to look shrewd and *incredulus-odi-ish*, than to give any good reason for our unbelief; and if the result of process, however well accredited, is to be believed in, till the nature of that process has been satisfactorily explained, we must be content to suspend for the present our belief in our own existence." (*Rudiments of Physiology*, Pt. ii. p. 12.)

[g] Sir Everard Home (*Phil. Trans.* 1825. p. 75. sqq.), and, according to Burdach who considers the occurrence of monstrosity from this cause to be an incontestable fact (§ 360.) Bechstein (*Gemeinnuetzige Naturgeschichte*, i. 17. sq.), Stark (*Archiv. für die Geburtshülfe*, v. 574.), Schneider (*Journal für Geburtshülfe*, x. 86. xvi. 121.), Sachs (*Hist. Nat. Duor. Leucœthiop.* p. 3.), Balz (*Medezin. Zeit.* v. 190.), Klein (Meckel's *Deutches Archiv*, ii. 235.), Carus (*Zur Lehre von Schwangershaft*, i. 217.), Brandis (Hufeland's *Journal der Pract. Heilkunde*, 1815. 38.), Hoare (Gerson's *Magaz.* vii. 470.), Toone (*Ib.* viii. 130.), have given examples in its favour. Baer, whose name will carry weight, relates the following fact:—

"A pregnant woman was greatly alarmed at the sight of a lengthened flame in the direction of her native place; as she was at a distance from this of 14 leagues, it was long before she learnt the place of the fire, and this protracted uncertainty probably acted forcibly upon her imagination, for she afterwards declared she had the figure of the flame constantly before her eyes. Two or three months after the fire, she gave birth to a girl with a red patch on her forehead, pointed, and like an undulating flame. This still existed at the age of 7 years. I relate this fact because I know all the particulars, for the individual was my own sister; and I heard her complain before her delivery that she had the flame constantly before her eyes; so that we were not obliged in this case, as in most others, to refer to the past in order to explain the anomaly." (Contribution to Burdach, § 359.)

In St. Giles's workhouse is a woman 30 years old, with a remarkably small narrow head, looking like an elderly child, very idiotic, saying nothing but aye and no, and in incessant motion. She was born in a state of chorea, and before her birth the mother was for the last two months of pregnancy annoyed and sometimes overcome by her violent movement. All this had followed "an extreme nervous illness" occasioned by a frightfully disgusting object thrown upon her bosom" in the fourth month of pregnancy. (*Lond. Med. Gazette*, May 23. 1833.)

I have seen a child with so exact a likeness of a leech full of blood and hanging down with its point highest, on the leg of the child of a lithographic printer, that at a little distance any one would suppose a leech was there. The mother told me that in her fourth month of pregnancy she had occasion to apply some leeches: that one remained longer than the rest and hung down full of blood. This rather frightened her and she dreamt about it. Mr. Hillas of Holborn, her accoucheur, through whose kindness I saw the child, informed me that, when the child was born and he observed the mark, he asked the mother if she had been frightened or had longed for any thing. She replied by asking if the child was marked; and, on receiving an answer in the affirmative, said, Oh! it must be with a leech; and then related the same particulars which she afterwards told me. A remarkable case was published in the *Lond. Med. and Physic. Journal* for July 1828, by Mr. George Bennett, so well known for his contributions to natural history. A woman gave birth to a child with a large cluster of globular tumors growing from the tongue and preventing the closure of the mouth, in colour, shape, and size, exactly resembling our common grapes; and with a red excrescence from the chest as exactly resembling in figure and general appearance a turkey's wattles. On being questioned before the child was shown her, she answered that while pregnant she had seen some grapes, longed intensely for them, and constantly thought of them, and once was attacked by a turkey-cock. Both growths were successfully removed, and Mr. Bennett was kind enough to allow me to see them.

success of Jacob's stratagem[h] with their contempt for the vulgar belief, they best can tell.

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[h] "And Jacob took him rods of green poplar, and of the hazel and chestnut tree; and pilled white strakes in them, and made the white appear which was in the rods. And he set the rods which he had pilled before the flocks in the gutters in the watering troughs, when the flocks came to drink, that they should conceive when they came to drink. And the flocks conceived before the rods, and brought forth cattle ringstraked, speckled, and spotted." (*Genesis*, xxx.) Some have argued that, because Jacob dreamt the rams which leaped were ringstraked, speckled, and grisled, they were so. If they had been, he would have seen them speckled, &c. when he was awake. The dream represents only that the effect taking place was the same as if the rams had been speckled, &c.

"Jacob the patriarch, by force of imagination made peckled lambs, laying peckled rods before his sheep. Persina, that Æthiopian queen in Heliodorus, by seeing the picture of Perseus and Andromeda, instead of a blackmoor, was brought to bed of a fair white child; in imitation of whom, belike, an hard-favoured fellow in Greece, because he and his wife were both deformed, to get a good brood of children, *elegantissimas imagines in thalamo collocavit*, &c. hung the fairest pictures he could buy for money in his chamber, *that his wife, by frequent sight of them, might conceive and bear such children.* And, if we may believe Bale, one of Pope Nicholas the Third's concubines, by seeing of a bear, was brought to bed of a monster. *If a woman* (saith Lemnius) *at the time of her conception, think of another man present or absent, the child will be like him.* Great-bellied women, when they long, yield us prodigious examples in this kind, as moles, warts, scars, harelips, monsters, especially caused in their children by force of a depraved phantasie in them. *Ipsam speciem, quam animo effigiat, fetui inducit:* she imprints that stamp upon her child, which she conceives unto herself. And therefore Ludovicus Vives (lib. 2. *de Christ. fem.*) gives a special caution to great bellied women, *that they do not admit such absurd conceits and cogitations, but by all means avoid those horrible objects, heard or seen, or filthy spectacles.*" (Vol. i. Part i. sect. 2.)

M. Girou Buzareingues mentions that a violent blow was given to a bitch while being lined; that she was paraplegic for some days, and, when she produced her eight pups, all, excepting one, had the hind legs wanting, malformed, or weak. (*Journal de Physiolog.* t. vii.)

Mr. Milne gives an account of a pregnant cat of his own, the end of whose tail was trodden down with great violence and excruciating pain. She produced five kittens, perfect except in the tail, which was in each of them distorted near the end, and enlarged into a cartilaginous knob. (*Linnæan Transact.* vol. ix. p. 323.)

Such cases are explained by Burdach and others on the ground of a sympathy between the injured part and the fœtus. But the general principle of the power of the mother's mental impression is sufficient to embrace them. For, 1. there must be the mental impression in these accidents. 2. Where the mutilation has been in another individual—the male, the effect may occur; so that mutilations

A curious fact is recorded on the authority of the late Earl Morton. He bred, from a male quagga and a mare of seven-eighths Arabian blood, a female hybrid, displaying in form and colour her mixed origin. The mare was given to Sir Gore Ouseley, who bred from her first a filly and then a colt, by a fine black Arabian horse; but both these in their colour and in the hair of their manes strongly resembled the quagga. The resemblance appears to have been rather less in the colt than in the filly. Dr. Wollaston soon afterwards learnt a similar fact in the case of a sow, which, after littering by a boar of the wild breed, was put, long after the death of this, to a boar of a different breed, and produced pigs, some of which were marked like the first boar; and even in a second litter by a third boar some slightly resembled the first.[1]

(*suprà*, p. 1114.) made intentionally or accidentally in the male have been supposed capable of hereditary transmission: unless this be from mental impression in the male. 3. Burdach, to illustrate the sympathy, cites Stark for the case of a pregnant woman bitten severely in the genitals by a dog and giving birth in three days prematurely to a child with traces of lesion in its glans penis and subsequently subject to fits of epilepsy, before which it always awoke, jumped up, and cried out that a dog was biting him, though this had never happened. However the following very remarkable case from the *Medical Times* of Feb. 29. last, suggests another explanation. For a woman who witnessed a mutilation in another,—an amputation, produced a child with only a stump: but the sight of this stump caused another pregnant woman to bring forth a child with a similar stump.

"Maria Juster of Minchinhamptom, Gloucestershire, aged six years, met with an accident, a broad-wheeled waggon having passed over her arm, which so much mutilated it as to require immediate amputation. Mary Brinksworth (who was about two months advanced in pregnancy) took the child to the hospital, and was present at the operation for the removal of the arm. At the full time of utero-gestation she was delivered of a boy with the left hand and wrist off just above the pronator quadratus muscle. When her child was about fourteen months old he was suddenly shown to Maria Westôn of Nailsthorp, who was then pregnant and about six weeks advanced. At the sight of the child's arm (to use her own expression) 'she became sick and faintish,' and continued ill for an hour. At the end of the nine months of pregnancy she was delivered of a girl with the left hand and arm deficient from about the insertion of the deltoid muscle. The arms of the two latter children which I saw presented exactly the appearance as if they had been amputated. I took the above from the statements of the two mothers (Mary Brinksworth and Maria Weston) of the two children at the dispensary, June 4. 1839."

One fact runs through all these cases, and, as it alone can explain some, it probably explains all.

[1] *Phil. Trans.* 1821, Pt. i.

The same happens in the human subject; for the following case was communicated to me on undisputable authority. "A lady, æt. 19, was married to a gentleman of a consumptive tendency, æt. 21. At the end of a year she bore him a son. The child died of hydrocephalus, æt. 2; the husband, the year following, leaving the lady a widow at 22. At 26 she married again, and had issue six children, — the last a boy. As he grew up, it was remarked by all the friends of the first husband and admitted by the mother herself that her sixth child was more like her first husband than his own father. Moreover, though born of robust parents without any consumptive tendency, he is delicate, and subject to tracheal irritation and chest attacks; but is now grown up, living, and in good health."[k]

Some suppose that the impregnating influence of the male before former pregnancies influenced ova *immature at that time.* Just as in the plant-louse and some others an impregnation lasts for a dozen or more generations, and in the fowl one tread will cause a score of fecundated eggs to come forth in succession, though all but 2 or 3 must have been immature at the time, and even cause others, also fecundated, to come forwards afterwards without a repetition of copulation. One impregnation serves the bee for 2 years or for life.[l] But the society of a gelded animal, or of an entire animal without copulation, may perhaps have the same effect. "One of the most intelligent breeders," says Mr. Boswell, "I ever met with in Scotland, Mr. Mustard, of Angus, told me that one of his cows chanced to come in season, while pasturing on a field, which was bounded by that of one of his neighbours, out of which an ox jumped, and went with the cow until she was brought home to the bull. The ox was white, with black spots, and horned. Mr. Mustard had not a horned beast in his possession, nor one with any white on it. Nevertheless, the produce of the following spring was a black and white calf with horns.[m]

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[k] These facts are of high importance in a civil point of view.

A married man may have a brother very like himself. He may die. The brother may be on the same terms of friendship with the widow as before: and the widow may marry another man, and produce a child clearly resembling the brother because it resembles the first husband, who has influenced the offspring of the second; and the woman's character may suffer unjustly.

[l] When the roebuck copulates in July or August, it may not be with young till after January nor bring forth till May: in such a case, the previous fecundation must have operated long afterwards,—when a vesicle had at length become mature. (See Pockel's, in Muller's *Archiv für Anatom.* 1836. p. 193.) Hausman says that the female fox has no fœtus in March though she have been with the male in January. (Burdach, § 301.)

"I had a pug bitch," says Mr. Blaine, "whose constant companion was a small and almost white spaniel dog of Lord Rivers' breed, of which she was very fond. When it became necessary to separate her, on account of her œstrum, from this dog, and to confine her with one of her own kind, she pined excessively; and notwithstanding her situation, it was some time before she would admit of the attentions of the pug dog placed with her. At length, however, she did so: impregnation followed; and, at the usual period, she brought forth five pug puppies, one of which was elegantly white, and more slender than the others. The spaniel was soon afterwards given away, but the impression remained; for, at two subsequent litters (which were all she afterwards had), she presented me with a white young one, which the fanciers know to be a very rare occurrence. The late Dr. Hugh Smith used to relate a similar instance which occurred to a favourite female setter that often followed his carriage. On one occasion, when travelling in the country, she became suddenly so enamoured of a mongrel that followed her, that, to separate them, he was forced, or rather his anger irritated him to shoot the mongrel, and he then proceeded on his journey. The image of this sudden favourite, however, still haunted the bitch, and for some weeks after, she pined excessively, and obstinately refused intimacy with any other dog. At length she accepted a well-bred setter: but when she whelped, the Doctor was mortified with the sight of a litter which, he perceived, bore evident marks, particularly in colour, of the favoured cur, and they were accordingly destroyed. The same also occurred in all her future puppings: invariably the breed was tainted by the lasting impression made by the mongrel."[n]

There could be nothing but imagination in the case, detailed by Stark[o], of a pair of pigeons, which, having lost their own young one, had a young blackbird put into their nest. This they continued to take care of during the next incubation, and their fresh young was no longer like them, as the former had been, but in colour and marks the perfect image of their adopted stranger.[p]

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[m] Quarterly Journal of Agriculture.

[n] *Intermarriage*, p. 275. sqq.

[o] *Beiträgen zur Psychischen Anthrop.* i. p. 291.

The effect of the mind in generation is shown by the circumstance of a hen laying far more eggs than she otherwise would, if one of those already laid is removed from the nest daily, though no fresh sexual intercourse take place. Every bird lays a definite number, and if any are removed she continues laying till the number is completed. A swallow naturally lays six eggs; but Lister, by taking some away successively, caused one to lay nineteen. The remarkable power of the mind in maintaining the secretion of milk was shown at p. 841. note [c]. Every one acknowledges the power of the mind in causing both functional and organic diseases, and in maintaining and varying the health. Now generation is subject to all the laws of every other function. Just as too many forget that the brain is but like every other organ; that every organ has its own peculiar function, the brain as well as the rest; but that every organ is subject to the same general laws, and that the brain differs not at all in this point of view from others: so generation has been thought peculiar in every respect. Writers speak of it as mysterious; just as if it was more mysterious than any thing else,—as if all was not mystery to us poor creatures. It is a process of secretion, excretion, movement, &c., like other functions; and the organs and function of generation are subject to all the cerebral influences, healthy and morbid, to which other organs are subject, though the function is peculiar.

With civilisation and barbarism favourable changes appear certainly connected. We should beforehand be inclined to imagine that the most excellent developement of every animated species would be effected where all its wants were best supplied, its powers all duly called forth, and all injurious or unpleasant circumstances least prevalent: and *vice versâ*. Every one knows the effect of cultivation in the vegetable kingdom. It "often converts a single flower into a double one, by the metamorphosis of its stamens into petals, or by the developement of a row of petals previously abortive, or by the change of the smaller tubular florets of a composite flower (like those composing the eye or disk of the dahlia) into flat expanded florets which constitute the ray. Cultivation has a similar effect in obliterating the spines, prickles, and thorns, from the surface of many plants; a change which was fancifully but not improperly termed by Linnæus 'the taming of wild fruits.'"[q] The apple and cabbage have been altered by cultivation equally with the dahlia; and, if the seeds of any of these are dropped in a poor soil, plants are produced approximating to the original type of the species. All horses, the Shetland pony and Arabian racer, have a common origin; as well as the Newfoundland dog and the Italian greyhound; and owe their differences to external circumstances. For if they return to a state of nature, as is the case with the dogs introduced into Cuba by the Spaniards, and the horses and wild cattle which are now spread over the plains of South America, the differences of breed disappear and a common form prevails. More than this, *instincts, dormant for ages, through external circumstances are excited into activity*, for the wild horses of South America herd under a leader, like those of Asia which have never been domesticated.[r] But experience teaches us that changes brought about in an animal after birth are not in general transmitted to the offspring: the causes of change in a species must therefore operate, not by altering the parents, but by disposing them to produce an offspring more or less different from themselves. Such is John Hunter's view of the question[s], and it is certainly confirmed by every fact. Yet circumstances, which produce a change in the offspring by acting *through* the parent

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[p] Frisch declares that a bird hatched by one of a different species is as unfit for procreation as a mule; Faber, that a drake hatched by a hen copulates with hens more willingly than with ducks; Bechstein, that a variety of pigeons with black wings and tails, whose young are never unlike their parents in colour, have a few red feathers in their wings or tails when they have been hatched by another variety which has an intermixture of red feathers. (Burdach, § 359.) If this is true, it shows an influence not indeed mental, but capable of penetrating a shell.

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[q] Mr. Carpenter, l. c. p. 419.

[r] "It seems," says Mr. Lyell, "reasonable to conclude that the power bestowed on the horse, the dog, the ox, the sheep, the cat, and many species of domestic fowls, of supporting almost every climate, was given expressly to enable them to follow man throughout all parts of the globe, in order that he may obtain their services and they *our* protection." "Unless some animals had manifested in the wild state an aptitude to second the efforts of man, their domestication would never have been attempted. If they had all resembled the wolf, the fox, and the hyæna, the patience of the experimentalist would have been exhausted by innumerable failures before he at last succeeded in obtaining some imperfect results: so, if the first advantages derived from the cultivation of plants had been elicited by as tedious and costly a process as that by which we now make some slight additional improvement in certain races, we should have remained to this day, in ignorance of the greater number of their useful qualities." (*Introduction to the Study of Geology.*) The *fly* attends man, equally with the dog.

The same difference in the form of the head and the colour are observed in originally wild horses, and in a race sprung from tame horses which have run wild again in Eastern Siberia. (Pallas, *Voyage en Sibérie.*)

The skull of the domesticated swine differs from that of the wild boar. Wild horses have proportionally larger heads than tame, with foreheads round and arched. (Pennant, *History of Quadrupeds.*)

The skin of the ass by domestication becomes softer and loses the small tubercles which are dispersed over the surface of the wild animal and enable the Levantines to make the grained leather called *chagrin.* (Buffon, *Sur la Dégénération des Animaux.*)

Horses and oxen have run wild in South America, and, the climate being congenial to them, have multiplied prodigiously. The wild horses are chestnut or bay brown; all the wild oxen of a reddish brown at the upper part of the body, and black every where else. But the tame horses and oxen are of all colours. (Cazara, *Voyage dans l'Amérique Mérid.* t. i. p. 178. sq.)

Dr. Prichard considers that " it has been proved by M. Serres that sufficiently characteristic differences may be traced between the skeletons of the dog and the wolf, the fox and the jackal, to constitute separate species; but it does not appear that any such distinctions can be established between the different breeds of dogs. The figure of the skull and the proportionate length of the limbs in comparison with the trunk differ in the different races, and the instinct displays some corresponding varieties, the animal being naturally impelled to procure its prey by the aid of those organs, whether of sight or of smell, which are more fully developed in each breed. In the *most highly domesticated races,* it appears that the *cranium is more fully developed* and recedes further from the form of the skull proper to the wolf, than in those which are less cultivated, though there is no strongly marked line of discrimination. The mastiff resembles the wolf most; in proceeding from the mastiff to the spaniel all the differences become greater. (l. c. vol. i. p. 352.)

[s] I fear that John Hunter has not generally the credit of this observation, but the following passage shows it to be clearly his. " As animals are known to produce young which are different from themselves in colour, form, and disposition, arising from what may be called the unnatural mode of life, it shows this curious power of accommodation in the animal economy,— that although education can produce no change in the colour, form, or disposition of the animal, yet it is capable of producing a principle which becomes so natural to the animal that it shall beget young different in colour and form; and so altered in disposition, as to be more easily trained up to the offices in which they have been usually employed; and having these dispositions suitable to such changes of form." (*On the Wolf, Jackall, and Dog,* l. c.)

may produce the same change likewise in the parent *in* a certain degree, although the change in the latter is *not* the cause of the change in the offspring.

Uncivilised nations exposed to the inclemency of the weather, supported by precarious and frequently unwholesome food, and having none of the distinguished energies of their nature called forth, are generally dark coloured and less distant from brutes in conformation; while those who enjoy the blessings of civilisation, *i. e.* good food and covering, with mental cultivation and enjoyment, generally acquire in the same proportion the Caucasian characteristics. The different effects of different degrees of cultivation, says Dr. Smith, " are most conspicuous in those countries in which the laws have made the most complete and permanent division of ranks. What an immense difference exists in Scotland between the chiefs and the commonalty of the Highland clans. If they had been separately found in different countries, the philosophy of some writers would have ranged them in different species. A similar distinction takes place between the nobility and peasantry of France, of Spain, of Italy, of Germany. It is even more conspicuous in Eastern nations, where a wider difference exists between the highest and the lowest classes in society. The naires or nobles of Calicut, in the East Indies, have with the usual ignorance and precipitancy of travellers been pronounced a different race from the populace; because the former, elevated by their rank, and devoted only to martial studies and achievements, are distinguished by that manly beauty and elevated stature so frequently found with the profession of arms: especially when united with nobility of descent: the latter poor and laborious, and exposed to hardships without the spirit or the hope to better their condition, are much more deformed and diminutive in their persons, and in their complexion much more black. In France, says Buffon, you may distinguish by their aspect not only the nobility from the peasantry, but the superior orders of nobility from the inferior, these from citizens, and citizens from peasants." — " The field slaves in America," continues Dr. Smith, " are badly clothed, fed, and lodged, and live in small huts on the plantations, remote from the example and society of their superiors. Living by themselves, they retain many of the customs and manners of their ancestors. The domestic servants, on the other hand, who are kept near the persons, or employed in the family of their masters, are treated with great lenity, their service is light, they are fed and clothed like their superiors, they see their manners, adopt their habits, and insensibly receive the same ideas of elegance and beauty. The field slaves are in consequence slow in changing the aspect and figure of Africa. The domestic servants have advanced far before them in acquiring the agreeable and regular features, and the expressive countenance of civilised society. The former are frequently ill shaped; they preserve, in a great degree, the African lips, and nose and hair. Their genius is dull, and their countenance sleepy and stupid. The latter are straight and well proportioned, their hair extended to three or four, sometimes even to six or eight inches: the size and shape of their mouth handsome, their features regular, their capacity good, and their look animated."[t]

Dr. Prichard has "been assured by persons who have resided in the West Indies, that a similar change is very visible among the Negro slaves of the third and fourth generation in those islands, and that the first generation differs considerably from the natives of Africa."[u]

Dr. Hancock the American traveller, in a letter to Mr. Walker, writes,—"It has appeared to me that very obvious changes are produced in a few generations independently of intermarriage. We find in Negro families which have long dwelt with those of the whites as domestics, that successive generations become less marked in their African features, in the thick lip and flat nose: and with skins of a shining black, they gradually acquire the European physiognomy. This is more especially visible among the older settlers, and in the smaller islands, such as St. Kitts, Nevis, Montserrat — where there had been but small accessions of native Africans. Under such circumstances we may often distinguish a Dutch Negro by the countenance alone. This difference can scarcely be described by words, but frequently we observe that obliquity of the eye so common to the Hollander.[x]

The South Sea Islanders, who appear to be all of one family, vary according to their degree of cultivation. The New Zealanders, for example, are savages and chiefly black; the New Hollanders, half civilised and chiefly tawny; the Friendly Islanders are more advanced and not quite so dark, several are lighter than olive colour, and hundreds of European faces are found among them.

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[t] *On the Causes of the Variety in the Complexion and Figure of the Human Species*, p. 85. sq.

[u] l. c. Ed. 2. t. ii. p. 565. sq.

[x] *Intermarriage*, p. 279.

The people of Otaheite and the Society Isles are the most civilised and the most beautiful: the higher orders among them have a light complexion and hair flowing in ringlets; the lower orders, less cultivated, are less pleasing.

"The same superiority," says Captain King[y], "which is observable in the Erees (nobles) throughout the other islands, is found also here (Owyhee). Those whom we saw were, without exception, perfectly well formed; whereas the lower sort, besides their general inferiority, are subject to all the variety of make and figure that is seen in the populace of other countries."[z]

There is no question that the cultivation of any organ or power of the parent will dispose to the production of offspring improved in the same particular.

"Every one conversant with beasts knows that not only their natural, but many of their acquired qualities are transmitted by their parents to their offspring. Perhaps the most curious example of the latter may be found in the pointer.

"This animal is endowed with the natural instinct of winding game, and stealing upon his prey, which he surprises, having first made a short pause, in order to launch himself upon it with more security of success. This sort of semicolon in his proceedings man converts into a full stop, and teaches him to be as much pleased at seeing the bird or beast drop by the shooter's gun as at taking it himself. The staunchest dog of this kind, and the original pointer, is of Spanish origin, and our own is derived from this race, crossed with that of the fox-hound or other breed of dogs, for the sake of improving his speed. This mixed and factitious race of course naturally partakes less of the true pointer character; that is to say, is less disposed to stop, or, at least, he makes a shorter stop at game. The factitious pointer is, however, disciplined in this country into staunchness; and what is most singular, this quality is in a great degree inherited by his puppy, who may be seen earnestly standing at pigeons or swallows in a farm-yard. For intuition, though it leads the offspring to exercise his parent's faculties, does not instruct him how to direct them. The preference of his master afterwards guides him in his selection, and teaches him what game is better worth pursuit. On the other hand, the pointer of pure Spanish race, unless he happens to be well broke himself, which in the South of Europe seldom happens, produces a race which are all but unteachable, according to our notions of a pointer's business. They will make a stop at their game as natural instinct prompts them, but seem incapable of being drilled into the habits of the animal which education has formed in this country, and has rendered, as I have said, in some degree, capable of transmitting his acquirements to his descendants.

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[y] Cook, *Voyages*, vol. iii. book v. c. 7.

[z] If the kingdom of Hayti continues, some highly interesting physiological questions will be determined: — We shall know what cultivation the African race is capable of, and what influence civilisation has upon the system of successive generations.

"Acquired habits are hereditary in other animals besides dogs. English sheep, probably from the greater richness of our pastures, feed very much together; while the Scotch sheep are obliged to extend and scatter themselves over their hills for the better discovery of food. Yet the English sheep, on being transferred to Scotland, keep their old habit of feeding in a mass, though so little adapted to their new country: so do their descendants; and the English sheep is not thoroughly naturalised into the necessities of his place till the third generation. The same thing may be observed as to the nature of his food, that is observed in his mode of eating it. When turnips were introduced from England into Scotland, it was only the third generation which heartily adopted this diet, the first having been starved into an acquiescence in it. In the same manner it required some years to establish the English practice of bringing up calves by hand in Scotland; the first who were so fed being cheated into swallowing milk, as the English calves at first are, by dipping the finger in the bowl and giving it the animal to suck. Nor was this mode of administering nourishment (slowly and reluctantly admitted by Lowland calves) ever, I believe, cordially adopted by their mountain kindred. The Highland beast has shown himself the worthy imitator of the Highland man, and is as obstinate in his opposition to this, as his Celtic master is to any other southern improvement which can be offered to him."[a]

Mr. Knight many years ago[b] advanced that bees and every species of domestic animal acquired "an irresistible propensity to do that which their predecessors of the same family have been taught to do through many successive generations." He stated, "that a young Terrier, whose parents had been much employed in destroying Polecats, and a young Springing Spaniel whose ancestry through many generations had been employed in finding Woodcocks, were reared together as companions, the Terrier not having been permitted to see a Polecat or any other animal of a similar character, and the Spaniel having been prevented seeing a Woodcock or any other kind of game; and that the Terrier evinced, as soon as it perceived the *scent* of the Polecat, very violent anger; and as soon as it *saw* the Polecat, attacked it with the same degree of fury as its parents would have done. The young Spaniel, on the contrary, looked on with indifference; but it pursued the first Woodcock which it ever saw, with joy and exultation of which its companion the Terrier did not in any degree partake."[c]

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[a] *Thoughts and Recollections by one of the last Century.*

[b] *Phil. Trans.* 17.

[c] *Phil. Trans.* 1837. p. 365. "Woodcocks are driven in frosty weather, as is well known, to seek their food in springs and rills of unfrozen water, and I found that my old dogs knew about as well as I did the degree of frost which would drive the woodcocks to such places; and this knowledge proved very troublesome to me, for I could not sufficiently restrain them. I therefore left the old experienced dogs at home, and took only the wholly inexperienced young dogs; but to my astonishment, some of these, in several instances, confined themselves as closely to the unfrozen grounds as their parents would have done." (p. 366.) "The most extraordinary instance," Mr. Knight adds, "of the power of instinctive hereditary propensity which I have ever witnessed, came under my observation in the case of a young dog of a variety usually called Retrievers. The proper office of these dogs is that of finding and recovering wounded game, but they are often employed for more extensive purposes, and are found to possess very great sagacity. I obtained a very young puppy (only a month old) of this family, which was said to be exceedingly well bred, and had been brought to me from a distant county. I had walked up the side of the river which passes by my house, in search of Wild Ducks, when the dog above mentioned followed me unobserved, and contrary to my wishes, for it was too young for service, not being then quite ten months old. It had not received any other instruction, than that of being taught to bring any floating body off a pond, and I do not think that it had ever done this more than three or four times. It walked very quietly

It is impossible not to suppose that similar results upon human offspring by educating the parents may be obtained. Mr. Knight thus writes to Mr. Walker. "A celebrated French civil engineer, M. Polonceau, visited me some years ago, bringing with him a young French gentleman who spoke English eloquently, and perfectly like an Englishman, though he had been in England only two years, and, as he assured me, knew nothing of the language previously, nor had ever heard it spoken. I asked him whether he could pronounce the English name Thisslethwaite; and he instantly pronounced it most distinctly and perfectly. The next day, when talking of other matters, he said that he had some Irish relations; and it appeared that his grandmother, on the female side, whom he had never seen, was an Irishwoman. Hence arose, I do not at all doubt, his power of so readily pronouncing the word I had prescribed. A French gentleman at Paris boasted to me that he could pronounce correctly any English word. I proposed Thisslethwaite to him, when, instead of trying, he exclaimed, '*Ah barbare!*'."[d]

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behind my gamekeeper upon the opposite side of the river, and it looked on with apparent indifference while I killed a couple of Mallards and Widgeons, but it leaped into the river instantly upon the gamekeeper pointing out the birds to it, and it brought them on shore and to the foot of the gamekeeper, just as well as the best instructed old dog could have done. I subsequently shot a Snipe, which fell into the middle of a large nearly stagnant pool of water, which was partially frozen over. I called the dog from the other side of the river and caused it to see the Snipe, which could not be done without difficulty; but, as soon as it saw it, it swam to it, brought it to me, laid it down at my feet, and again swam through the river to the gamekeeper. I never saw a dog acquit itself so well, yet it was wholly untaught. I state the circumstances with reluctance and not without hesitation, because I doubt whether I could believe them to be well founded upon any other evidence than that of my own senses; the statement is nevertheless perfectly correct." (p. 367. sq.)

Other functional changes are effected in the offspring through the parents although they could not be brought about in the parents themselves. Englishmen carried out greyhounds to hunt hares in Mexico. The great platform where they hunt is about 9,000 feet above the level of the sea, and the ordinary height of the barometer is 19 inches. The greyhounds could not support a long chase in the thin atmosphere; and lay down gasping before they came up with their prey. But their whelps do not suffer in the least from the attenuation of the atmosphere, and run down the hares with as much ease as the best hounds in England. (Lyell.)

[d] *Intermarriage*, p. 178. sq.

Climate, however, has not been shown to have no effect: but its power, being in itself not generally very considerable, cannot be strongly manifested when opposed. In fact, a diminution of the sun's influence does dispose to the production of light varieties: the inhabitants of hilly situations are, *cæteris paribus*, fairer than the people below, and persons of the same tribe and degree of civilisation lighter in the northern parts of Europe and Asia than those in the more southern; whiteness, too, is very common in the North among animals which nearer the equator are variously coloured; a pair of brown mice kept in a dark place are said to generate a white offspring. Blumenbach mentions that small birds fed on hemp-seed in a chamber, become black.[e] Some statements have been lately made respecting New South Wales, that show the influence of the climate of that country to be considerable.

"It appears, indeed, that the change which takes place in the physical constitution of *all kinds* of animals on transplantation to New South Wales, is something quite astonishing. It was long since remarked, that prostitutes who had never borne children in Europe, became prolific mothers in the Australian colonies, and that married women who had long left off child-bearing, recommenced, in some cases even at the advanced period of fifty years, after a short residence in these regions; and the observation appears to be confirmed, that not only the human race, but most of the quadrupeds produced from animals imported, improve their breed and increase considerably in size. Mr. Dawson, the intelligent manager of the Australian Agricultural Company, thus writes in a private journal with which we have been favoured. 'Both the climate and the soil appear by nature intended to produce fine wool and fine animals too, even from the worst beginnings. The latter seems a paradox. The extensive range that can be afforded to every animal keeps it in good condition, and, perhaps, the native grasses may have more of good in them than their appearance indicates. However this may be, the climate clearly has a wonderful effect on the size of all animals, even upon man, who is almost universally tall here, although born of diminutive parents. From this I am led to believe that the climate governs chiefly, and thus every breeding animal introduced here will attain a size not known in Europe. From what

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[e] *Med. Gazette*, No. 2.

I know of the origin of the breed of horses introduced here, and the size of the stock that has almost promiscuously been produced from them, I have strong grounds for inferring that the produce of such horses as we have imported will be something extraordinary.'"[f]

Bishop Heber, in speaking of India, says, "It is remarkable to observe how surely all these classes of men (whites, — Persian, Greeks, Tartars, Turks, and Arabians), in a few generations, even without any intermarriage with the Hindoos, assume the deep olive tint, little less dark than a Negro, which seems natural to the climate. The Portuguese have, during three hundred years' residence in India, become as black as Caffres. Surely this goes far to disprove the assertion which is sometimes made, that climate alone is insufficient to account for the difference between the Negro and the European. It is true that in the Negro are other peculiarities which the Indian has not, and to which the Portuguese colonist shows no symptom of approximation, and which undoubtedly do not appear to follow as naturally from the climate as that swarthiness of complexion which is the sole difference between the Hindoo and the European. But if heat produces one change, other peculiarities of climate may produce other and additional changes, and where such peculiarities have three or four thousand years to operate in, it is not easy to fix any limit to their power. I am inclined, after all, to suspect that our European vanity leads us astray in supposing that our own is the primitive complexion, which I would rather suppose was that of the Indian, half way between the two extremes, perhaps the most agreeable to the eye and instinct of the majority of the human race. Colder climate and a constant use of clothes may have bleached the skin as effectually as a burning sun and nakedness may have tanned it; and I am encouraged in this hypothesis by observing that of animals the natural colours are generally dusky and uniform, while whiteness and a variety of tint almost invariably follow domestication, shelter from the elements, and a mixed and unnatural diet. Thus while hardships, additional exposure, a greater degree of heat, and other circumstances with which we are acquainted, may have deteriorated the Hindoo into a Negro, opposite causes may have changed him into the progressively lighter tints of the Chinese, the Persian, the Turk, the Russian, and the Englishman."[g]

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[f] *Quarterly Review*, Jan. 1828, p. 7. Review of *Two Years in New South Wales, &c.* by P. Cunningham, surgeon, R. N. 1827.

"Where the mountains of intertropical Africa rise or are continued into high plains or into steppes of considerable elevation, the physical characters of the inhabitants are generally those which are termed European, and the continuity of surface being favourable to a nomadic life, such nations, as for example the mountaineers of Caffa and Enarca, and the hordes termed Gallas, approximate, in their habits and manner of life, to the pastoral tribes of Northern Asia. In the Negro countries, properly so called, the natives of higher districts are observed to be physically superior to those of low and swampy valleys; and there is, perhaps, an equal difference in their manifestation of intellect and mental vigour."[h]

"On the plantation of Ulster, and afterwards on the successes of the British against the rebels in 1641 and 1685, great multitudes of the native Irish were driven from Armagh and the South of Down into the mountainous tract extending from the Barony of Flews eastward to the sea; on the other side of the kingdom the same race were expelled from Leitrim, Sligo, and Mayo. Here they have been almost ever since, exposed to the worst effects of hunger and ignorance, the two great brutalisers of the human race." The descendants of these exiles are now distinguished physically from their kindred in Meath and other districts where they are not in a state of physical degradation. They are remarkable for "open projecting mouths, with prominent teeth and exposed gums; their advancing cheek bones and depressed noses bear barbarism in their very front."

"In Sligo and the northern Mayo the consequences of two centuries of degradation and hardship exhibit themselves in the whole physical condition of the people, affecting not only the features but the frame, and giving such an example of human deterioration from known causes as almost compensates by its value to future ages for the suffering and debasement which past generations have endured in perfecting its appalling lesson." "Five feet two inches upon an average, pot-bellied, bow-legged, abortively featured; their clothing" a wisp of rags, &c. "These spectres of a people that once were well grown, able-bodied and comely, stalk abroad into the daylight of civilisation, the animal apparitions of Irish ugliness and Irish want." In other parts of the island where the population has never undergone the influence of the same causes of physical degradation, it is well known that the same race furnish the most perfect specimens of human beauty and vigour both mental and bodily.[1]

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[g] *Narrative of a Journey through the Upper Provinces of India, from Calcutta to Bombay*, by the late Reginald Heber, D.D. Lord Bishop of Calcutta, p. 54. sq.

[h] Dr. Prichard, *Researches*, vol. ii. p. 53.

Volney gives us a singular instance of the power of climate upon different races; not, indeed, in producing variety, but in mysteriously affecting generation.

"During five hundred and fifty years that there have been Mamlouks in Egypt, not one of them has left subsisting issue: there does not exist one single family of them in the second generation; all their children perish in the first or second descent. Almost the same thing happens to the Turks; and it is observed that they can only secure the continuance of their families, by marrying women who are natives, which the Mamlouks have always disdained. Let the naturalist explain why men, well formed, and married to healthy women, are unable to naturalise on the banks of the Nile, a race born at the foot of Mount Caucasus! and let it be remembered, at the same time, that the plants of Europe in that country are equally unable to continue their species! Some may refuse to believe this extraordinary fact, but it is not on that account less certain; nor does it appear to be new. The ancients have made observations of the same nature: thus, when Hippocrates asserts, that among the Scythians and Egyptians, all the individuals resemble each other, though they are like no other nations; when he adds, that in the countries inhabited by these two races of men, the climate, seasons, elements, and soil possess an uniformity nowhere else to be found, does he not recognise that kind of exclusion of which I speak? When such countries impress so peculiar a character on every thing native, is it not a reason why they should reject whatever is foreign? It seems, then, that the only means of naturalising animals and plants would be to contract an affinity with the climate, by alliance with the native species; and this, as I have before said, the Mamlouks have constantly refused. The means, therefore by which they are perpetuated and multiplied, are the same by which they were first established; that is to say, when they die, they are replaced by slaves brought from their original country."[k]

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[1] *Dublin University Magazine*, No. 18.; also Dr. Prichard, l. c. vol. ii. p. 349.

Being curious on this point, and having a most intelligent and valued friend, the late member for Ripon, who travelled in Turkey, Syria, and Egypt, and even spent seven months in the Desert of Arabia, I applied to him for information, and received the following note:—

"Dear Elliotson, *Limmer's Hotel, March* 3. 1828.

"I have just received your note, and have great pleasure in giving you what information I am able on the subject of the Europeans in Egypt. You asked me yesterday if I had not told you Volney was incorrect in the statement he has made in p. 108. concerning the Mamlouks? I do not remember having told you any thing to that effect: the subject which he seems to have been misinformed upon is the climate of Syria, which does not interest you.

"From the various inquiries I made in Egypt I consider Volney to be perfectly correct. The persons whom I asked had never read his work, and till I asked them had never given their attention to the subject; yet still they could not bring one instance to their recollection of the children (of two whites) born in the country ever coming to maturity. I was also told that children begotten by Europeans out of natives (a circumstance which, however, rarely happens, owing to the Copts and Arabs being very particular on that subject) entirely lose their appearance of European origin in the third generation. The physiognomy of the Copts is very striking; I never remember seeing the least European mixture, which would be visible if they had made alliances with the Turks who are as different in the form of face as can be well imagined,—the Turks have Roman noses; the Georgians Grecian; the Mamlouks both; but the Copts are *snubs*.

"I was told at Damietta, the port on the eastern branch of the Nile, that an Italian family had flourished amazingly; afterwards I heard the mother was a Maltese, which, if true, more strongly corroborates the fact, as the Maltese are supposed to be of Arabian origin; they speak a kind of jargon so like Arabic as to make themselves understood by the natives on their arrival in Egypt.

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[k] *Voyage en Egypte et en Syrie*, t. i. p. 87. sq.

"What Volney also says about the vegetables is equally true. When I left Cairo, a gardener hearing that I was going to Jaffa and Damascus, and likely to return, begged me to bring him melon and cauliflower seed, as, though those plants thrive exceedingly well in Egypt, unless the seed be renovated constantly, it degenerates so as quite to become another plant. This is also the case, I understand, with the Brussels sprouts, so celebrated in the Netherlands. Plants raised from seed from Brussels thrive well in this country; but seed saved here, though it ripens thoroughly, greatly degenerates in the second generation.

"The race of Mamlouks has been entirely destroyed by the present Pacha, Mahommed Ali. Only a few escaped the general massacre in the citadel, and fled to Dongola. These few have been gradually dying off. When I was in Cairo I heard from a person lately arrived from Abyssinia that only a *very* few were left. One old man, the only *one* in Cairo, I used to see daily in a public garden. I had some conversation with him several times, but he was quite superannuated, and could give no information. In fact, had he been capable, his life would not have been spared.

"Ever your's most truly,
"J. S. Crompton."

The effect of civilisation on corporeal strength was proved by Peron[1], who ascertained, by means of Regnier's Dynamometer, the bodily power of the complete savage of Van Diemen's Land to be inferior to that of the more cultivated New Hollander, of the latter to that of the still more cultivated inhabitant of Timor, and of the last very considerably to that of Europeans. The weakest Frenchman was equal in the hands to the strongest man of Van Diemen's Land, and the weakest Englishman stronger than the strongest New Hollander: the *average* strength of Europeans in the loins exceeded that of the most powerful individuals of either Van Diemen's Land, New Holland, or Timor.

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[1] *Voyages des Découvertes aux Terres Australes.*

Perfection, in other words, the highest compatible point of utility or agreeableness, or of both, is nature's universal aim in her productions; but it is in general obtained slowly, and the more so in proportion to the excellence or degree of the qualities to be perfected. Animals and vegetables have to pass one period before they burst into birth, and another before their full powers and proportions are reached; and man, whose perfections are very excellent, arrives at his acmé very late.

It is in this respect with species as with individuals, — their improvement is gradual.

The fact of the improvement of progeny by the operation of all favourable causes upon parents is highly encouraging. Horace, in his invective Ode against the vices of the Romans, says,

"Ætas parentum, pějor avis, tulit
Nos nequiores, mox daturos
Progeniem vitiosiorem:"[m]

But as happy circumstances will tend to the production of a better progeny, we have great encouragement to exert all our energies for the improvement of mankind, whatever distress we must feel for our disappointments in individuals of whom we had thought well and for whom we have done much. Ordinarily a certain amount only of improvement by education can be effected in an individual. He generally stops at last; and defies all efforts to advance him farther. Happily he dies, with all his uneradicable prejudices. His offspring has them not, or not so fixed; and it would seem that the offspring is likely to be still better organised than the parent, through the good influences exerted upon the parent.

In vegetables and brutes, whatever improvement is made by good management of external circumstances, there is a constant tendency to fall back to the original state, so that constant cultivation is required.[n] It is the same with us; and the neglect of the physical and mental means of improvement will cause an inferior progeny to be established. But, great as this influence is, and greatly as we ought to rely upon it, that of the breed is very far stronger; and, though almost entirely neglected by individuals, should always guide marrying people. No one has spoken better or more plainly on this point than Burton in his *Anatomy of Melancholy*.[o] It is thought that not only a good cross within the same nation is always desirable, but that a cross between two nations begets offspring superior to either. The importance of crossing an inferior nation by a better is shown by

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[m] *Carm.* lib. iii. 6.

[n] M. Roulin, in a paper read to the Academy of Sciences in Paris in 1829, stated that in South America the brutes from Europe soon acquired more or less of their wild characters. The hog, wandering in the woods and subsisting on wild fruits, becomes very ferocious and assumes almost the character of the wild boar. The bulls and cows soon became wild, and could be kept in subjection by repeated battues only. By the independent character which the horse

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leads, it resumes nearly the character of the wild horse, and remarkably resembles it in colour.

Variety is less difficult to accomplish in some species than in others: and is transmitted with different degrees of facility: and sometimes is soon lost again; sometimes it becomes permanent, and this especially when it has been effected with difficulty.

[o] Pt. 1. sec. ii. mem. 1. subs. 6. "An husbandman will sow none but the best and choicest seed upon his land; he will not rear a bull or an horse, except he be right shapen in all parts, or permit him to cover a mare, except he be well assured of his breed; we make choice of the best rams for our sheep, rear the neatest kine, and keep the best dogs; *quanto id diligentius in procreandis liberis observandum?* and how careful then should we be in begetting of our children? In former time, some countries have been so chary in this behalf, so stern, that, if a child were crooked or deformed in body or mind, they made him away; so did the Indians of old (by the relation of Curtius), and many other well-governed commonwealths, according to the discipline of those times. Heretofore, in Scotland (saith Hect. Boëthius) *if any were visited with the falling sickness, madness, gout, leprosie, or any such dangerous disease, which was likely to be propagated from the father to the son, he was instantly gelded; a woman kept from all company of men: and if by chance, having some such disease, she were found to be with child, she with her brood were buried alive:* and this was done for the common good, lest the whole nation should be injured or corrupted. A severe doom, you will say, and not to be used amongst Christians, yet more to be looked into than it is. For now, by our too much facility in this kind, in giving way for all to marry that will, too much liberty and indulgence in tolerating all sorts, there is a vast confusion of hereditary diseases, no family secure, no man almost free from some grievous infirmity or other. When no choice is had, but still the eldest must marry, as so many stallions of the race; or, if rich, be they fools or dizzards, lame or maimed, unable, intemperate, dissolute, exhaust through riot, (as he said) *jure hæreditario sapere jubentur;* they must be wise and able by inheritance; it comes to pass that our generation is corrupt; we have many weak persons, both in body and mind, many feral diseases raging amongst us, crazed families, *parentes peremptores;* our fathers bad; and we are like to be worse."

the great improvement of the Persians, who were originally ugly and clumsy, ill made and rough skinned, by intermixing with the Georgians and Circassians, the two most beautiful nations of the earth. "There is hardly a man of rank in Persia who is not born of a Georgian or Circassian mother; and even the king himself is commonly sprung, on the female side, from one or other of these countries."[p] But when one nation is not surpassed in any particular quality by another, I doubt whether this quality is improved by the cross: the superior race cannot gain, but must lose. Unfortunately, few nations are not inferior in some things, and national crossing is therefore generally useful; for there is less chance of the same defects meeting in the two, than when they marry among themselves. What is excellent in the one nation must be deteriorated by mixture with the low degree of the same in the other. Crossing among nations may be more advantageous, as being more decided, than crossing among individuals of the same nation. But without care it may be an evil.

[p] Lawrence's *Lectures.*

APPENDIX.

DIGESTION.

Since the publication of the First Part of this work, I have learnt that a rare opportunity of studying the function of digestion has occurred and been turned to excellent account by Dr. Beaumont in America.[a]

A Canadian youth, 18 years of age, had a fistulous opening of the stomach, left after a gunshot wound. In June, 1823, a year after the accident, an external opening into the stomach, nearly 2½ inches in circumference, existed. Early in the winter a small fold of the inner membrane began to appear, which gradually filled the opening, preventing egress, but was easily pushed back with the finger.

When the stomach was empty, it always contracted upon itself, and the valve of mucous membrane, equal in size to a hen's egg, was forced through the orifice. After he had slept a few hours on the left side, the protruded portion became so much larger as to spread over the neighbouring integuments to a circumference of 5 or 6 inches, so that the mucous membrane could be well examined. Dr. Beaumont ascertained that the gastric juice is not secreted in the intervals of digestion, nor does it accumulate to be ready for the next meal.

As soon as food came into contact with the mucous membrane, the blood-vessels enlarged with blood; the membrane, from being pink, became red; the temperature is always 100°. This is in accordance with the general fact, that during its function every part becomes more or less turgid with blood; and if, by a contrivance of structure, the blood does not pass away from a part

[a] *Experiments and Observations on the Gastric Juice and the Physiology of Digestion.* By W. Beaumont, M.D. Plattsburgh, 1833.

as quickly as it arrives, this becomes much larger, — experiences erection. The peristaltic action of the stomach increased, and innumerable minute lucid points and very fine papillæ arose, from which oozed a clear, colourless, inodorous, and acidulous-tasting, slightly viscid fluid, which collected in drops on the points of the papillæ, and trickled down the sides of the stomach till it mingled with the food. This was the gastric juice. Mechanical or any cause of irritation, as well as food, occasioned the same result. The fluid would keep unchanged almost any length of time.

It always bore a direct relation to the quantity of food required by the system, not to the quantity taken.

Whenever a feverish state was induced by undue stimulants or emotion, the mucous coat became sometimes red and dry, and at others pale and moist, and lost altogether its smooth and healthy appearance. If the state increased, no gastric juice could be procured even on the application of the usual stimulus of food.

Although the contact of any indigestible substance immediately excited the secretion, fluid ceased to flow as soon as it proved that the substance could not be acted upon.

When an ounce of masticated fresh beef was placed in an ounce of gastric juice, it was partially digested in 2 hours if kept at a temperature of 99°, but scarcely changed if the temperature was but 34°.

In the same experiment as the last, but with cold water instead of gastric juice, the beef seemed merely a little macerated. In 6 hours, the beef in the warm vial was half digested; but that in the two others, had experienced no farther alteration. At the end of 24 hours, the beef in the warm vial, 4 drachms of gastric juice having been previously added because the original quantity could dissolve no more, was completely dissolved and exhibited the usual appearance. The portions in the cold juice and cold water were softened and similar, and without any appearance of chyme. The vial with cold gastric juice was now placed in a sand bath at blood heat. In a very short time digestion commenced and advanced as regularly as in the other parcel.

When portions of meat were suspended in the stomach by a string, so short as to prevent them from being fully subjected to the peristaltic action, the influence of the gastric juice was confined almost entirely to the surface, and longer time was requisite for their solution.

Meat in a vial of gastric juice was dissolved sooner if gently agitated: and when 2 ounces of unmasticated roasted beef were introduced through the opening into the stomach, and confined by a string, only half was digested in 4 hours.

When a few spoonfuls of soup were introduced through the orifice, the folds of the mucous membrane gently closed upon it, and completely prevented the entrance of a second quantity till it was diffused: relaxation then occurred, and a fresh supply was admitted. When solid food was thus introduced, either in larger pieces or finely divided, the same gentle contraction and grasping motion began, continued for from 50 to 80 seconds, and more could not be introduced till the contraction was at an end. If the man was so placed that the cardia could be seen, and he then swallowed a morsel, a similar contraction and closure of the stomach upon the bolus always took place, and, till this was over, a second morsel could not be received without great effort.

The disturbance of digestion by taking fresh food before the last meal has left the stomach is ascribed by Dr. W. Philip to the fresh food becoming surrounded by the former and thus, not being exposed to the gastric juice, remaining unchanged. But, as all the contents become intimately mixed and equally exposed to the gastric juice, Dr. B. ascribes the disturbance to the supply of gastric juice being all expended on the first meal, and the stomach not being yet ready to secrete again.

The peristaltic action of the stomach is at first comparatively slow and feeble, and grows rapid and energetic as chymification advances: and at the same time the gastric juice becomes more acid. Chyme begins to form in a quarter of an hour after deglutition, and the contents to lessen almost as soon as food is swallowed. The food is gradually impelled to the pylorus, which contracts and refuses admission to every undigested portion. If any portion is in its nature indigestible, or the stomach having temporarily lost its power cannot digest, the pylorus, after refusing egress for some time, at length contracts no longer and allows the undigested food to pass.

Drink was carried off by absorption and did not go through the pylorus.

An ounce of gastric juice, after a fast of 17 hours, was poured into a vial, and 3 drachms of recently salted beef put into it: the vessel was corked tightly, and immersed in water of 100°. In 40 minutes, digestion had distinctly begun on the surface: in 60, chyme was formed: in 90, the muscular fibres hung loose and floated in shreds: in 3 hours, they had lessened to half; in 5, few were undissolved; and in 9, the solution was perfect. But, when a similar piece was introduced into the stomach, it was completely dissolved in 1½ hour. The difference arose from the circumstance of the peristaltic action causing every fresh portion to be successively exposed.

When the man swallowed a mouthful of any tenacious food after the digestion of the preceding meal was considerably advanced, it always passed towards the great curvature and then disappeared. In a minute or two it reappeared, more or less broken down, and mixed with the general alimentary mass; and, in a short time more, it was so changed as to have lost its identity. From this and numerous other facts, Dr. Beaumont infers, contrary to Dr. Prout, &c. (*suprà*, p. 81.), that "there is a perfect admixture of the whole ingesta during the period of alimentation and chymification;" and that "the whole contents of the stomach, until chymification be nearly complete, exhibit a heterogeneous mass of solids and fluids — hard and soft, coarse and fine, crude and chymified — all ultimately mixed, and circulating promiscuously through the gastric cavity, like the mixed contents of a close vessel, gently agitated or turned in the hand." As Dr. Combe justly remarks[c], this we must have supposed the case on reflecting upon the contents of the stomach when vomited.

When Dr. Beaumont extracted a portion of the food through the opening half an hour or an hour after eating, he always found it composed of perfectly formed chyme and particles of food intimately mixed and blended; and every portion so completely supplied with gastric juice, that its chymification proceeded with no other aid than proper temperature and agitation till the whole was digested.

Dr. B. put 12 drachms of recently salted beef into a phial with 12 drachms of gastric juice obtained after a fast of 18 hours; and

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[b] In the same experiment with chicken, the solution was slower; from the greater compactness of cooked chicken.

[c] *The Physiology of Digestion*, &c., by Andrew Combe, M. D.; all of whose books are of the greatest practical utility; and, in common with his phrenological papers, show excellent sense.

kept it agitated in water at 180° in a sand bath. Digestion soon began, and, after continuing with uniformity for 6 hours ceased. One half of the meat was found dissolved, the rest being only loose and tender, — undigested. Only 6½ drachms of beef were found to have been digested by the 12 drachms, — nearly double its weight of gastric juice. Hence we see why an excess of food is not digested. In such circumstances, digestion was resumed upon Dr. B. adding more gastric juice.

At 20 minutes after a common dinner of beef, vegetable substance and water, Dr. B. drew off a portion of the contents of the stomach into a vial. This was placed in a water bath at 100° for 5 hours: and was then found perfectly dissolved; insomuch that little difference was detected between it and a second portion of the same food taken from the stomach at the end of the 5 hours, though the process was rather slower; 20 minutes having sufficed for the adequate supply of gastric juice for digestion.

After a meal of 18 ounces of recently salted lean beef, 4 ounces of potatoes, 4 ounces of boiled turnips, and some bread, portions were withdrawn at successive periods. At 15 minutes, some of the meat was found slightly digested: at 45, fragments of beef and bread were perceptible, but the former was in small shreds and pulpy, and the fluid was more opake and gruel-like. At 2 hours, nearly all the meat was chymified and changed to a reddish brown fluid: but small pieces of vegetable matter now presented themselves for the first time, yet less advanced in digestion than the beef, so that their structure was visible. Some of the 2d and 3d portions, treated in a vial as usual, became quite digested, as in the other experiment, except that the process was slower, and a few vegetable fibres remained to the last undissolved.

Milk and albumen were always coagulated by the gastric juice in the first instance.

When vegetable soup was taken with beef and bread, the fluid was so absorbed in 50 minutes that the contents were even thicker than after eating more solid food.

When acescent fruits and vegetables were eaten, the pulp in the stomach, at the end of an hour, was acrid and irritated the edges of the aperture and the rest of the mucous membrane; and still more acrid at the end of 1½ hour: and, though the stomach was empty at the end of 2 hours, it still had an appearance of irritation. A pint of sweetened rich boiled sago or of custard was digested in 2 hours, and occasioned neither acrimony nor smarting of the edges of the opening.

Food finely divided before it was introduced into the stomach was digested almost as soon as food masticated and moistened with saliva.

Animal and farinaceous aliments were of more easy digestion than what are commonly called vegetables.

The time generally required for the disposal of a moderate meal of the fibrous parts of meat, bread, &c., was from 3 to 3½ hours.

Bile was not ordinarily found in the stomach.

PHRENOLOGY.

In a former part of this work I showed the injustice of Dr. Spurzheim towards Gall,—his gross attempts to share with Gall discoveries in which he had no participation, and to make it appear that he had rendered systematic and philosophical what had been in Gall's hands rude and detached facts. My object was not "the exaltation of Gall over all the other phrenologists, physiologists, and anatomists;" for I did not suppose that a man existed, however low his knowledge, in whose eyes he was not exalted above all other phrenologists, and, as phrenology is the physiology of the brain, above all other physiologists in regard to the brain, and above all anatomists as far as regards the same organ. On the anatomy and physiology of other parts than the nervous system, Gall has written nothing. My convictions resulted from my sense of truth; and my only motive was love of justice. For with Gall I had no intimacy, and against Spurzheim no animosity. When Gall was in London, I saw him once at Deville's, when his cast was taken; once at St. Thomas's Hospital, where he went to present himself to Sir Astley Cooper; and once at the Phrenological Society: and on no one of these occasions did I exchange twenty words with him. Dr. Spurzheim's intimate friends had so disparaged him to me both as a phrenologist and a man that I neither called upon him nor attended his lectures, never having read his works, but having studied those of Dr. Spurzheim only. After I had read his works, I called upon him in Paris for three minutes on my way to Switzerland in 1826; and, on my return, I called twice upon him. In 1827, when in Paris on my way home from Italy, I spent a whole day with him, and made him two calls. I never saw him afterwards, nor did I ever correspond with him.

Dr. Spurzheim I knew very well; attended his lectures, and had always been on good terms with him. A few days before he left England for the last time, I believe, but one, I sat next him at a dinner party, and accidentally expressed my regret that he had not given fuller demonstrations of the brain in the course of Phrenology which he had just finished, as several medical men as well as myself had attended the course principally for the purpose of becoming conversant with the new anatomy of the brain and profiting by it in examining the organ when diseased. He told me that an acquaintance with the old anatomy was just as useful for pathological investigations, and that he was not in the habit of spending more time on the anatomical part of the subject than he had done in this course. Nothing more passed; and I had no idea he was displeased. The next day I received a note from him containing the two guineas I had paid him for the course, and expressing the impossibility of his keeping the fee as I was not satisfied. I returned the money, assuring him, as nearly as I can recollect, that, since I had attended all the lectures and learnt all that he proposed to teach, the money was justly his; and that it had been an error of mine to suppose that the amount of anatomy would be greater than it had been. However, he sent back the money a second time, informing me that when I received it he would have left England. Conceiving that the money was not mine, I requested a friend to return it to him at Paris, with a short note something like the first, I believe; and a letter came to me afterwards from Dr. Spurzheim, stating that he had sent the two guineas to the Westminster Hospital. This was the whole affair. I had no quarrel, nor did I think of quarrelling, with Dr. Spurzheim. So far from it, that, at the invitation of a young man at whose father's house he stayed, I went to the house by appointment with him to meet Dr. Spurzheim, that I might be shown some proofs, by Dr. Spurzheim himself, of the existence of what he called the organ of Conscientiousness. I was in the house an hour; but Dr. Spurzheim never made his appearance, and left the house, I afterwards found, rather before I did. I then fancied he might be offended: but I had done nothing calculated to offend an amiable man, and I felt no displeasure with Dr. Spurzheim.

I formerly stated (p. 333.), that Gall frequently employs the word *we* when speaking of himself only. In vol. vi. 8vo. p. 279. he uses the word *nous* when professedly writing alone. " Finissons comme *nous* avons commencé à dire, &c." p. 391. vol. ii. "*Nous* avouons que nous ne sommes pas en état." vol. i. p. 106. "Tout ce que *nous* venons d'alléguer," &c. vol. v. p. 491. "Dans la préface qui est à la tête du premier volume de *mon* grand ouvrage, voici comment *je me* suis exprimé." p. xxxi. "*Nous espérons*," &c. See vol. vi. p. 405. "*J'ai* eu bien raison de dire," &c.

Although Gall says, "In 1805 *we* demonstrated it" (the unfolding of the brain); in the same page he writes, "*I* demonstrated in *my* lectures;" and he twice calls it *my* discovery.

Again, "It is the observation of hydrocephalic heads which led *me* to the discovery of the unfolding," &c. "M. Sömmerring, attempted to deprive *me* of the honour of *my* discovery," &c. (8vo. vol. ii. p. 266. sq.) In fact, Gall supported a hydrocephalic woman in his house for years, in order to ascertain the state of the brain after death; yet Dr. Spurzheim has the effrontery to claim the discovery of the true mode in which the brain unfolds in hydrocephalus. Gall says, "The first volume of *my* great work which contained the anatomy of the nervous system and especially that of the cerebrum and cerebellum did not appear until 1809; but for several years before my travels, *I* constantly gave at Vienna the demonstration of the brain according to *my* discoveries." He then goes on to say that in 1805-6-7, "*we* gave *the same demonstration* of the brain;" showing (see *suprà*, p. 331.) that Dr. S. was his assistant in demonstrating his anatomical discoveries, and that what was done after he had hired Dr. S. was what had always been done before. Indeed, Dr. S. incautiously allows that he was a mere assistant at Gall's lectures, for he says, in his notes to Mr. Chevenix's article, "In our public as well as private demonstrations of the brain, I always made the dissections and Dr. Gall explained them to the auditors;" *i. e.* he was the mere prosector to the lecturer Gall. This is one instance for all of the sense in which Gall used the word *we*.

He continues. "During my journey, several of *my* auditors published *my* lectures." (8vo. vol. vi. p. 181. sq.) In the same page he speaks of the memoir written by himself, but to which he kindly affixed Dr. S.'s name with his own in these terms. "*We* presented to the Institute of France a memoir containing an account of *our* anatomical discoveries." But that he used the plural merely because he had kindly joined Dr. S.'s name to his own appears from the very next sentence, in which he writes, "and M. Rolando knew nothing of *my* anatomical and physiological doctrine, except as an absurd opinion refuted by Malacarne! They made *me* maintain," &c. "A much more evident proof that M. Rolando has not appropriated *my* discoveries," &c. In vol. vi. pp. 28, 29, Gall, having employed Dr. S. as his dissector and assistant to investigate for him according to his instructions ("*I* have repeated and *ordered* to be repeated hundreds of times the researches upon the brain, *suprà*, p. 333."), says "Nobody has examined so many brains as Dr. S. and myself. All *our* predecessors cut up this noble organ into a thousand bits," &c. But continues, "*I* have placed myself above all authority. *I* have broken the ice, and *I* have established a method of philosophical and physiological dissection.". "To form a judgment upon *my* anatomical system," "it is indispensable to know *my* method of examining the brain, and *my* discoveries." Though Gall wrote every line of the *Mémoire* presented to the Institute, and the *Observations* in reply to the report, and kindly put Dr. S.'s name to it with his own, calling the one *our* report and the other *our* answer, and using the word *we* and other plurals; yet, when speaking of this work, in his 6th volume, p. 46., he declares at once it was all his own. "*I* have refuted, &c. in a pretty long passage, &c."[a] "The Committee have pretended that *my* doctrine upon the structure of the brain has no necessary and immediate connection with *my* doctrine upon the functions," &c. His sole right to what he gave their joint names is shown at p. 32. "This is the way in which *I* expressed myself in *our* answer to the *Report* of the Commissioners." "Every one knows that in all our writings and all our works, *we* announce *my* doctrine as the Anatomy and Physiology of the nervous system in general and of the brain in particular. *I* have constantly declared that examinations of skulls and heads were necessary to arrive by observation at a knowledge of the different cerebral portions. This part of *my* doctrine," &c. (vol. ii. p. 33.) In the observations he says, if *we* ourselves had not found the decussation of the pyramids, it would have been impossible for *us*, &c. Yet Gall taught the decussation before Dr. S. became his pupil, as Dr. S. confesses. (*Suprà*, p. 332.) In vol. ii. p. 41. Gall says, "All who have attended *our* lectures and read *our* works are astonished at their immense number (the facts)." The 1st volume and part of the 2d in 4to. bear the joint names of Gall and Dr. S.: yet in the Preface to the 3d volume Gall says, In the 1st volume of this work, *I* have detailed, &c. In the 2d, *I* have entered upon, &c." He everywhere speaks of the great work as entirely his own, and of himself as being considered in all his travels *the person* and the discoverer. "*I* everywhere received the most flattering reception; sovereigns, ministers, the learned, civil functionaries, artists, on all occasions seconded *my* views by increasing *my* collection and furnishing *me* with new facts. The circumstances were too favourable for *me* to be able to refuse the invitations which *I* received from most of the Universities. By this means *my* journey was prolonged much beyond the term which *I* had originally fixed; but so many public and private discussions upon *my* doctrine resulted, that it has acquired a degree of maturity which few founders of new doctrines have attained during their lifetime. This journey gave *me* the opportunity of studying the organisation of a great number of men,' &c. "*I* collected numerous facts," &c. "*I* levied contributions on many anatomical and physiological collections. *I* submitted ancient statues and busts to *my* observation, and *I* compared them with historical accounts. After having employed for so many years such numerous and diversified means, *I* no longer feared either the danger or the accusation of precipitating the publication of *my* great work." (8vo. vol. i. p. 16. sq.) In vol. i. p. 78. Gall boldly says in the face of Dr. S., "In the 1st volume of *my* great work." "*I* have treated," &c. "*I* have assigned," &c. "*I* have rectified. *I* have proved," &c. "*I* have detailed," &c. "*I* have proved," &c. "*I* have shown," &c. *I* have demonstrated," &c. "*I* have restored," &c. "*I* have proved," &c. "*I* have established, &c." "*I* have seized," &c. "*I* have demonstrated," &c. "What *I* have taken from touch *I* have given to sight," &c. "Thus *I* may refer *my* readers on all these points to *my* great work."

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[a] *Recherches sur le Système Nerveux, suivies d'Observations.*

I asserted that Gall sometimes uses the word *we* in the usual singular meaning of authors. "*I* know many Negroes," &c. and then, "from what *we* have just said." (ii. p. 335. sq.; see also vi. p. 161.) In vol. iii. he says at p. 78. "*We* have detailed the different opinions of the learned in vol. i. 4to." &c. and then in the next page, "*I* have proved in vol. i. 4to." &c. In vol. ii. 4to. where he is writing professedly alone and not referring to discoveries, he uses the plural like many authors. "*We* confess that *we* are not yet qualified to point out," &c. p. 379.

In many cases where he had employed *our* in the 4to. he says *my* in the 8vo. In the table of contents vol. ii. sect. 3., the expression "*our* principles" occurs five times. In the corresponding table, vol. i. 8vo., in every instance it is "*my* principles."

I have said (*suprà*, p. 331.) that no one ever thought of attacking Dr. S. for the new anatomy and physiology of the brain. Gall says, "Some speak of *my* discoveries, pretending to blame *me* and do honour to their professors; others claimed *my* discoveries as their own, without daring to point out the source of their riches; others published extracts from *my* lectures, but took good care not to name them; others were expelled from their learned societies for having declared themselves partisans of the extravagancies of the German doctor, 8vo. ii. 32. sq. "All know with what animosity they (Ackermann and Walter) attacked indifferently all *my* anatomical and physiological discoveries. Arrived at Paris *we* obtained at first the most brilliant success from *our* anatomical demonstrations. The highest scientific men were enchanted. Soon afterwards the Emperor arrived from his German campaign. I know not what panic seized the members of the Institute of France; but, as if by a charm, everything suddenly changed. All that *I* said, all that *I* demonstrated was now nothing but doating, quackery, and humbug as they chose to report it to this monarch," p. 14. sq. He then adds, "they ascribed *our* method of dissecting the brain," p. 15. although it is universally admitted that the mode of dissection had been long taught by him before he heard of Dr. S.'s name and was taught by him to his pupil Dr. S. His next words are "*I* have proved in *my* answer to this report that *our* method," &c.; "*our* predecessors;" "*we* must have made more researches if *we* had followed the steps of *our* predecessors instead of paving for *ourselves* a new road," &c. (ii. 16.) The whole world knows that Gall only opened this new road, and he himself declares it repeatedly, yet while saying "they have conceded eighteen essential points of *our* discoveries" (p. 17.),—all notoriously Gall's discoveries, *our* memoir,—declared by himself to be *his* own memoir, he goes on now with the singular —" *My* adversaries have seized," &c. "Agreed upon one point, to discredit *my* doctrine," &c. "Cuvier told me honestly when he was struck with *my* dissection," &c. "In what then does the plan of *my* researches differ from that of *my* predecessors? It is only after having familiarized *myself* with, &c., that *I* was able to seize the principles, &c. As soon as *I* found *myself* in the right road, *I* had but to persevere unremittingly, *adding* some *mechanical proceedings only;*" and this was before he had taught Dr. S. the anatomy or physiology of the brain. "Thus *I* succeeded in finding and placing in the rank of positive knowledge the structure, arrangement, gradual perfection, the connection and relation of the different parts of the brain. *I* have established order, unity, and life, in a study where there was previously nothing but confusion. Where nothing had been seen but mechanical forms and fragments *I* demonstrated apparatus for the manifestation of the moral and intellectual powers," p. 19. sq. Even when he speaks of his demonstrations made before Reid and Loder, who knew, as all Europe did, that he was the sole discoverer, and like all the world saw Dr. S., the young man fresh from college and hired by Gall as his prosector, merely as his humble assistant, and expressed their astonishment at Gall's discoveries, he says "the demonstrations which *we* continue to make," vi. p. 31. He had just before said *my* method of examining the brain and *my* discoveries, p. 28.

Where he really alludes to Dr. S. under the words *we* or *our* he no where considers him as more than a witness or an assistant; —the *hand* man of the *head* man. He spoke of others in the same way. "If Mr. Spurzheim, myself, and *so many others* affirm that *we* have learnt how to interpret these differences of development of the various portions of the brain, would it not be right, instead of denying such interesting correspondencies with a haughty indifference, to examine without prejudice how far observation confirms *my* pretended discoveries?" He alone lectured, yet (vol. i. p. 373.) he writes, "*We* detail in *our* course the numerous observations with which experience has furnished us; and *we* boldly declare *our* opinions."

Although Dr. S. originally spoke of the 4to. work as *our* work, he at last, as inconsistently as on other occasions, in his *Outlines* refers to it as Gall's only.

Everlastingly Dr. S. copies word for word from Gall and always without acknowledgment.

Gall had made all his great discoveries in the anatomy and physiology of the brain and taught them to the world before he knew Dr. S. The latter was a young man twenty years Gall's junior, who happened to attend his lectures, was convinced by Gall, and afterwards engaged by Gall as his dissector and general assistant. In all the travels Dr. S. spent not a farthing, but received pay from Gall like artists and others whom Gall had with him. The establishment was Gall's and Dr. S. never presumed to be thought of otherwise than a humble individual of Gall's suite.[b]

Gall told me that Dr. S. was at first the clumsiest assistant that he ever had; lost him a great deal by breaking his casts, &c. (for these were then scarce), and that it was twelve months before he could teach Dr. Spurzheim to dissect the brain, whereas he taught Dr. Fossati in two or three. Gall was all kindness and simplicity; he trusted that Dr. S. would carry on phrenology after his death, and, being quite easy about his own fame, since he and he alone was known all over Europe as the alleged discoverer of a new system of the anatomy and physiology of the brain, he thought he could lose nothing, but might serve Dr. S. and Phrenology by joining the name of Dr. S. with his own in his works. The *Mémoire* presented to the Institute, the *Observations* on the report of the Institute, and the great work were all composed and written by Gall only, and without the slighest participation by Dr. S. except as a mere clerk, who looked into other works for references and saw that the artists executed the engravings accurately. "Il sait," Gall openly told him, "qu'il n'a été chargé que de fournir les notes littéraires. (Gall, 4to. iii. xvii.) He examined this point and that in anatomy by Gall's direction;—Gall thinking, reasoning, and investigating,—mechanically obeying Gall's directions. Gall took him as his companion to every prison and other place of observation. On this very account Gall frequently speaks in the plural; giving their joint testimony to a fact. "Résumons *nous*,"

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[b] In 1802 Gall informed the Austrian government that he had spent 7000 guilders upon plaster casts of the skulls of men and brutes, and upon the models of the brains of men and brutes in wax, and above 15,000 guilders in preparing for his large work. See his interesting *Petition and Remonstrance* to the government of Austria, translated and printed by Messrs. Combe in their translation of his section on the cerebellum, &c. &c.

&c. The desire of enforcing his own assertions by adding the testimony of another; his wish to establish Dr. Spurzheim as his successor in advocating phrenology; his security with respect to his own merits and fame; and I must add a great carelessness in all that was not essential, are the reasons why he united Dr. S.'s name with his own, and spoke in the plural number.

That he never meant to allow Dr. S. any participation as an author or discoverer, is evident from his using the singular in a perfectly clear manner, excluding every other person, on those very points in which he even used the plural in a way that a Spurzheimite would conceive favourable to Dr. S.'s claim.

I have stated (*suprà*, p. 334.) that Gall after reading some of Dr. S.'s English work gave the book up in disgust half cut, and knew nothing more of Dr. S.'s sayings and writings afterwards than what was pointed out to him, and it was with the greatest difficulty that he could be prevailed upon to take notice even for a moment of what was pointed out to him. The notice in Gall's work of any thing by Dr. S. was through their pointing out to him certain passages in Dr. S.'s books. To be quite accurate, I wrote to Dr. Fossati for more precise information: and in a letter dated Nov. 27. 1838, Dr. Fossati answered, "Gall n'a pas tout lu ce que Spurzheim a écrit même de sa phrénologie, mais il l'a lu en partie; je crois qu'il s'était arrêté à Partie v. *Practical Considerations*, parceque les feuilles du livre n'étaient pas coupés, quand il est mort. Le livre sur l'éducation que je lui ai porté de Londres en 1822, il ne l'a pas lu. Les feuilles ne furent pas coupés. "Gall n'avait pas grande opinion de Spurzheim; il voyait dans le livre de quoi il était question; il trouvait des raisonnements qui ne lui allaient pas, et il fermait le livre pour ne plus l'ouvrir."

In a former letter Dr. Fossati writes, "Spurzheim n'a jamais reclamé les découvertes anatomiques, avancées alors comme les découvertes de Gall. Quand on parlait à Gall des découvertes de Spurzheim, il élevait les épaules, et il disait qu'il y avait trop d'écrits de son temps pour qu'il se donnât de la peine à cet égard."

In a letter dated Jan. 1836, "Gall disait qu'il avait fallu plusieurs années pour que Spurzheim fut habitué à saisir les formes des têtes et a distinguer les organes. Il lui rendait justice quant à son adresse dans l'anatomie; mais il soutenait toujours et devant tout le monde que c'est lui, Gall, qui lui avait appris l'anatomie du cerveau et la méthode de la disséquer."

To show how moderately Dr. S. was advanced in the science when he travelled with Gall, I may mention that Gall laughingly told me that when they went into a prison or any other building tenanted by a large number and he began to examine heads and pronounce his opinion, Dr. S. used to pull him back and make signs of intreating that he would not give opinions, so greatly did he fear that phrenology was scarcely competent for such judgments. Dr. S. never presumed to speak on these occasions.

I know none among the advocates of Dr. S. who is not miserably ignorant of the writings of Gall and of the history of phrenology, and has not derived his knowledge second hand from Dr. S. or from some one taught by him; and few who are not most unjust to Gall.[e]

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[e] Mr. G. Combe, in his reply to Dr. Roget (l. c. p. 197.), says "that the titles which Gall and Spurzheim give to their science are Phrenology." Now Gall nowhere calls it phrenology. He invariably contents himself with the expressions, Functions of the Brain; just as we say functions of the kidneys.

In translating Gall's treatise on the cerebellum, he of course gives Gall's footnote, who says that *it is reported* in the *Brittische Annalen* that a machine is used by debauchees in England to hang them a little and thus precure an erection. Mr. C. remarks in a foot-note of his own, "The idea is unworthy of Gall." (p. 93.) Now Gall does not say he has such an idea; he relates what he finds in a book without expressing any opinion, and with no other view than to show that it has been thought to apply the effect of hanging on the genitals to a practical purpose. Does Mr. Combe deny that there was such a machine in England for old gentlemen? or did he never hear the report, some twenty years ago, of an old gentleman having died in a certain house in London because he was let to hang rather too long?

At another part he has this foot-note: "The cerebellum was largely developed in Gall, and although the feeling did not subjugate his intellect, it produced irregularities of conduct which were reprehensible," p. 142. Now what good object could Mr. Combe have in writing this note? I again ask what worthy object could he have? He was not writing Gall's biography, but translating a treatise on the cerebellum. I have always heard that Gall was faithful to his first wife till they parted; that he then had a mistress to whom he was as faithful, and to whom he was married as soon as his first wife died. If Gall's cerebellum was very large he did not make it. A wag would think that perhaps Mr. C.'s is very small and that he envied Gall.

At p. 214, Mr. Combe says "Dr. Spurzheim found by observation that in an individual who manifests great self-esteem, a certain part of the brain is fully developed, and likewise that the individual carries his head high and reclining backwards" Why, "all this was found by observation by Gall before Dr. S. had heard of phrenology."*

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* To show that I am not alone in my views, I shall publish portions of letters

An array of references has been made to parts of Gall which refer to the writings of Dr. S.: on one occasion one reference, to me from two of the soundest phrenologists, both authors on the subject, and one indeed a phrenologist of nearly thirty years' standing, who, I feel persuaded, would not object to the publication of his name; but as I have not formally asked his permission, and he is too far off for an answer to be received under a length of time, I abstain from mentioning it.

"Like yourself I have often felt puzzled at the worship paid to Spurzheim. My own opinion was made up many years ago, the first time I read his preface to his Anatomy of the Brain. Every thing since has confirmed it; and where, in reading Combe, I used to read and admire,—ignorant of Gall, as, alas! most are,—when I read Gall I was amazed: all of the *good* was copied from Gall's words, *or from Spurzheim's unacknowledged plagiarisms.* Mr. Combe thought proper once to take me to task for my remarks on Spurzheim, as being the following of a 'too ready listening to what Dr. Elliotson had said.' I told him, as was just, that I was then totally unaware of your opinions, which you will remember to be the fact, since I was not aware of your opinions therein till *after* publication of my pamphlet in which my opinions were expressed. I rejoice at your exposures.

"Since I have studied Gall I have been completely astounded at the ignorance of Gall's mind which he shows, and at the same time the effrontery with which he plagiarises from him, when it suits his purposes, without a hint of acknowledgment.

"The edition I use is Capen's edition in 2 vols. Boston (U. S.), 1838.

"The cases of Spurzheim's plagiarism and dishonesty and direct falsehood are too numerous to point *all* out. It would occupy a volume. I confine myself chiefly to the *first* volume, and in that I have marked down the following pages as SPECIAL instances:—

"Pp. 11, 12. 15. 23. and 24. and following; 35. 40. 44. 51, 52. 56. and 57. 61. 64. 64. 66, 67. &c., 74. 95, 96. 102. 105. 116. 121. 124. &c., 126. &c., 130. 132. 135, 136. 139. 147. 153. 162, 163. 186, 187. 190. 195. 197. 202. 205, 206. 209. 236, 238. 305, 306, 307. 327. 334. 340.

"The greater part of vol. 2. is derived or copied *verbatim* from Gall,—see, *e. g.*, 107. and many following pages.

"I proceed to notice a few of the *more flagrant* of the above instances:—

"P. 11. The whole a complete misstatement and misrepresentation.
12. Directly false; three separate statements, in three first paragraphs.
23. &c. Copied almost *verbatim* from Gall.
35. Ditto.
40. &c. Gall's exact words — 44. copied.
51. Again, all before and after, copied:—and insolent presumption of "*Gall and I*" continually.
52. Copied from Gall again.

In his preface to the work he recklessly asserts, p. xxiv. "Drs. Gall and Spurzheim have the merit of having discovered and first taught the true anatomy extending into two pages, is made into two. But that may pass: I have only to remark that all the references, except a mere

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of the brain!" Why not say Drs. Gall and Spurzheim, Mr. Combe and Mr. Deville first established phrenology? Mr. G. Combe shows his absurd tendency

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57. Gall again.
61. All preceding ch. from Gall.
64. Ditto.
66. Insolence — and false in last parag. especially italicised '*our common.*'
67. All from Gall.
73. Ditto.
95. As to *theft, murder,* &c. *not true;* Gall justly showed their tendency in *excess* was this, and distinctly says so.
102. All this said merely to ape at a difference and superiority from Gall. Spurzheim well knew that Gall merely said it (as he elsewhere, copying Gall, says it) to prevent *quackery.*
105. The whole chapter ending here — from Gall.
116. All this section also.
121. Particular impudence: he says, '*it seems to me,*' when he copies Gall's *exact words* on same subject.
124. &c. *Particularly to be noticed.* Little else than a string of falsehoods of the most barefaced kind. *e. g.* Gall 'taking only situation of organs as guide,' when Gall classed them. Gall '*unacquainted with special faculties,*' when Gall, in each case, devotes much to this point. Middle parag. of p. 125. *impudently* false; and as to *bumps* ridiculously so: whole chapter should be well examined; where not falsehoods as to Gall, it is taken from Gall's words, — which is Spurzheim's usual way of striving to get credit — first decrying Gall and then copying his words.
130. Last parag. in chap.: — '*my work*' false and presumptuous.
132. Most impudently false passage in whole book: — '*Gall* did not determine organs in conformity with their views,' — when every point *copied from Gall.* (See especially § 2. of Gall's 3d vol. under his *definition of faculties.*) Can any thing be more barefaced or impudent? Gall laid down these rules (only in better terms than Sp.) and *applied* them, which Sp. does not.
135. Last parag. strives to find here excuse for his ignorance or laziness *against* Gall's beautiful and *most valuable* illustrations. Gall's is the only philosophic mode. — Turn over leaf for falsehood and absurdity. Every *case* quoted by Spurzheim is taken *unacknowledged* from Gall, as see p. 139. &c. &c.
153. Sp.'s '*Amativeness,*' '*Physical Love,*' against Gall's *Instinct of Propagation.* Compare with p. 124. *antè.*
162. Last parag. His usual insidious insinuation to seem as if Gall did little and *he* had determined the seat of 'Adhesiveness:' he knew *Gall* determined it thoroughly.

mention of the title of Dr. S.'s book on insanity, are to but one work, and that which Gall criticises at length in his third 4to

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to exalt Dr. S. unjustly in the following passage, p. 234.: "Many years ago Dr. S. and some other phrenologists inferred from the fact of motion remaining in

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186. '*I*,' &c. as usual. Gall on *contrary* calls it '*Instinct of defence of self and property*,' which is *complete*.
190. *Acquisitiveness*. All from Gall.
195. Gall expressly states *theft* to result from excess.
197. Copied from Gall: *much*, Gall's own words.
202. Usual misrepresentation. Gall *expressly* distinguishes between *coward* and to *feel fear*; and his argument beautifully shows difference between them and its cause.
205. Altogether misrepresentation of Gall.
206. *Impudently false*. Gall drew the finest line between Pride and Vanity *ever drawn*,—and yet Sp. dares to speak thus! Gall drew the most *graphic* distinction between *effects* of each,—and yet Sp. says he *confounds* them! Quote Gall's picture of *vain* man and *proud* man, in answer.
236. Gall discovered organ of 'wonder,' (see him on 'imitation') and yet Sp. claims, and his slaves give him, the discovery.
238. Remark as to Rousseau (*insinuated* against Gall) made by *Gall himself* and copied from him.
305. Gall never said forehead a *single* organ; he grouped the *whole* as forming '*the intellect*,' which Sp. had not philosophy to do.
306. *False*, that Sp. discovered 5 organs and more accurate than Gall; but love of approbation his ruling passion.
307. '*I*—*I*—*I*,' while copying Gall.
327. Third parag. '*I show*,' while copying Gall's words.
334. Sp. very bad on reflection; the little that is good is from Gall.
340. Directly *false* that Gall admitted not *feelings* and *intellect*; also, *Gall* observed on *time*. The constant aim of Sp. is to place *himself* in opposition to Gall, especially so in p. 340. See also same spirit in *Preface* to *Anatomy of Brain*."

The following is an extract from a letter from Dr. Forster, who gave the name of Phrenology to our science (*suprà*, p. 690.), and pointed out to Dr. S. that there must be an organ of marvellousness. (*Récueil des Œuvrages et des Pensées d'un Physicien et Métaphysicien*. Par Thos. Forster. Frankfort, 1836, p. 12.)

"In March, 1816, Professor Jamieson requested me to write a paper for the Wernerian Society at Edinburgh. I chose for my subject, Phrenology, comparative and human, and had about twenty elegant drawings made for its illustration; which, together with my paper, were exhibited at the Society in due course in the same month; so that I am the first person who announced Gall's doctrine in volume; and that all must know that he read Dr. S.'s Phrenology, though only as his friends pointed out parts to him.

Dr. S.'s conduct is only explicable by an inordinate amount of vanity, which made him so short sighted as not to see that the majesty of Gall's intellect and moral dignity would but make all unprincipled attempts to plunder him futile, and throw the poor offender for ever into the sink of all bad men. Take but two examples to illustrate his character. Gall long before Dr. S. knew anything of Phrenology had dissected the brain in his new way, and defended the decussation of the pyramids. But Dr. S. madly writes, "Modern anatomists before Gall and *myself* were

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some cases where feeling was lost and vice versâ, that the nerves must really be double." Any one would infer that till the time of Dr. S. no person drew this inference, whereas it was drawn by the ancients themselves long before Dr. S. was born; and in 1783 revived and defended by the French surgeon Pouteau. (*Suprà*, 19.)

Scotland, though Spurzheim with his wonted egotism took the credit of it. The next day the Professor Jamieson called on me and said that my doctrine had given offence and wounded the prejudice of the faculty and others, who thought it irreligious and also unsupported by facts; and, in short, that phrenology was unpalatable as a science in Edinburgh. He had previously proposed me as Hon. Member of the Society; but, from what he said, I was induced to request that no more notice of me should be taken by the Society, and I withdrew from Edinburgh in great disgust of the whole proceeding. To the best of my recollection, Gordon, Combe, and Mackenzie, were all against the doctrine violently. Subsequently, Spurzheim came and gave lectures in the autumn of the same year, and made some converts. But what is remarkable is this;—that I said prophetically, 'the seed is sown, inquiry on foot, and Edinburgh will be the first town to have a School of Phrenology.' So, indeed, it has turned out. Spurzheim always flattered me to my face, but abused me behind my back, as I learnt from several persons. The whole discovery is Gall's, just as the real source of the higher astronomy belongs to old Sir Will. Herschel, while the tyros and pupils take the credit of his labours. Gall was a good, honourable, humane man; and to have spoken of him as Spurzheim did to me, is a blot in the moral character of the latter, that qualities more useful than his would have been inadequate to counterbalance.

"Spurzheim behaved still more unhandsomely to me about the organ of *Wonder*, which I twice or thrice suggested to him in 1815 and 1816, and he denied its being a separate faculty. I called it *Mysterizingness* (see my *Sketch of Phrenology*, 8vo. London, 1815); he afterwards adopted the organ, and called it Wonder, &c., *without* acknowledgment."

divided in opinion on the subject of the decussation." "Before Gall and *I* began our researches, anatomists were in the habit of cutting down the brain by slices." (*Suprà*, p. 322.)

I have a firm conviction that, if Gall's 8vo. work had been translated, and neither Dr. S. nor Mr. Combe had published their works, Phrenology would by this time have been far better appreciated and understood, and would many years ago have been received as extensively as it is at present. At p. 389. I said, "It is greatly to be lamented that Gall's 8vo. work is not translated; and I am certain that the legacy left by a Scotch gentleman could not have been laid out to half the advantage in any other way than in publishing a cheap translation of it. Pure as were the motives of the gentlemen intrusted to fulfil the wishes of the spirited bequeather, in publishing works of their own, I am convinced that they would have done far better in publishing the writings of the founder before any thing else." This was courteously expressed, and made no charge, but regretted an error of judgment only. However, it gave great offence to the so styled *Phrenologorum facile Princeps*[d], who wrote to me, denying that money had been spent upon any work of their own, except the Constitution of Man, and sending me in print the reply that was to appear in the next edition of his Constitution of Man: — "Mr. Henderson's Trustees have published *no* works of their own at the expense of his funds. *Not a sixpence has been contributed to any work but the present*, and aid was *given to it at the bequeather's special request*." On receiving an assurance from me that I made no charge, but merely differed from their judgment, he wrote again and said that it was a direct charge; and that "in order to render the charge as little offensive as possible," I gave "them credit for the purity of their motives:" and that it would have been better not to have made such a charge against them at all, seeing that it was without foundation.

But as I had always understood that those who had entered upon the speculation of the *Phrenological Journal* had lessened their losses by sums from the bequest, I told him of this and he could not deny it. He confessed that the circulation was at one time so low that there was a great loss on every number: and the speculators therefore received 10*l*. a number from the bequest till they lost nothing. This was a very prudent measure, and showed wisdom in their generation: but after the confession of it, and my declaration that I neither made nor thought of making a charge, it was not very polite or reasonable in Mr. Combe to add, as he did, "If this was the only fact on which your charge was founded, it was very ill supported indeed."

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[d] *Statistics of Phrenology*, p. 9.

At length, however, truth and reason have prevailed; for Mr. Combe writes in the *Phrenological Journal* for April, 1839, p. 190., that I have reminded him that a donation of 10*l.* a number had been given from it in support of the *Phrenological Journal;* and that I am correct, and his expressions of denial too general. Indeed they were, for they were universal — "Not a sixpence has been contributed to *any* work but the present."

In keeping with this affair, I will now for the first time mention another. About 12 years ago I sent to Mr. Combe for the *Phrenological Journal,* a paper read by me to the Phrenological Society of London, with a title to this effect, and bearing my name. In it I casually expressed my regret that Dr. S. had not followed Gall's plan of detailing the origin and progress of each of his discoveries of organs and of laying a body of individual instances in proof to his readers; but merely made an assertion; so that one was inclined to think that he had reasoned himself into the belief of faculties, and then considered where their organs were most likely to lie; not having first met with the facts and extended his observations in consequence. Mr. Combe thought proper to strike this out of the paper without communication with me. When I complained, his apology was that the Editor was answerable for every thing in the *Journal,* and that differences among phrenologists were injurious; and that posterity would settle the respective merits of Gall and Dr. S. I replied, 1. That the paper professed to be a certain paper read at a certain place. If it was mutilated, it was not what it professed to be. 2. That, as it bore my name, the editor was not responsible for its sentiments, as in the case of anonymous reviews, in which every thing is considered as the Editor's. 3. That when a phrenologist is wrong, the sooner his error is corrected the better: the more error spreads, the greater will be the difficulty when the time arrives, as it always must, for its correction; so as to Gall and Dr. S., if the present generation of their cotemporaries allow injustice to prevail, posterity will have a fine argument in our silence that all was right and Dr. S. what he pretended to be.

MESMERISM.

"Credulity argues Weakness of Mind, and is, deservedly attended with Reproach. It is offensive to Philosophy; whose venerable Records it interlines with false Stories, and idle Tales. But, on the other hand, 'tis also true, that Scepticism is not less a fault; for that alone renders the whole Book of Nature insignificant. What can the clearest experiment, or the best discovery import to him, who will not hear, who will not see?"—*Phil. Trans.* vol. xx. p. 261. 1698.

"Galilée, Newton, Salomon de Caus, Volta, Fulton, Windsor, Arkwright, Gall, et tous ceux qui se sont présentés une vérité à la main à la porte de ce vaste Charenton, qu'on appelle le monde, ont été reçus à coup de pierres ou de sifflets."—*Jobard.*

In the second part of this work, published in 1827, I declared that I "should despise myself if I hesitated to declare my decided conviction of the truth of Mesmerism;" and added, just as I have stood abundant ridicule for advocating Auscultation, Phrenology, Quinine, Hydrocyanic Acid, and Creosote, and maintaining the liability of mankind to Glanders, never having yet declared an opinion upon a new medical truth that I had been obliged to retract, I "will now stand more ridicule with the same firmness and the same silent pity or contempt which I have always felt for my opponents, till I see, as I shall, the truth of Mesmerism established." (*Suprà*, p. 656.)

How I have up to this moment fulfilled my promise, the world knows. I have now for three years carefully and dispassionately investigated the subject by experiments performed almost every day upon a variety of persons; and I not only repeat my firm conviction of the truth of mesmerism, but of the truth of many points in it upon which I formerly gave no opinion, because I had not then witnessed them, and was determined to remain neutral upon every point on which I myself did not witness facts.

The production of the peculiar coma by mesmerism, independently of all mental impressions, is a truth now admitted by a very large number of the best informed, acutest, and least credulous men in England, whose attention was excited to the subject by what I showed them; for, though some of the seed which I sowed fell on stony ground and among thorns, much proves to have fallen upon good soil, and is now daily bringing "forth fruit, some thirty fold, some sixty, and some an hundred." This coma may be induced in some persons who have no idea of what is intended, and sometimes merely by pointing the fingers close towards them; in some, by doing so behind their backs, without their knowing that we are about any thing, or even that we are there; in some, who firmly disbelieve the whole matter[a]: in those who resisted all effect to their utmost; in those who are already in ordinary sleep; and in children completely idiotic. If it is complete, no pinching or other violence is felt during it, and, till the patient wakes spontaneously, possibly after many hours, or some days, there is perhaps no other mode of waking him but by transverse passes, darting the hand towards him, or blowing in his face. The case of Elizabeth Okey, related at pp. 628. sq. 682. *suprà*, has continued up to the present moment; and a sister rather younger than herself, taller, more robust, and of bustling and hardworking character, who had also been treated by others and myself in vain for epilepsy, fell into a similar state of ecstatic delirium, and was in this state when admitted into the hospital. When I first saw her, she was in the delirium, but almost instantly fell asleep on my putting my finger on her forehead. The sleep was very short; but returned whenever I re-applied my finger. Her case likewise has continued up to this time. Scarcely a day has elapsed in which Mr. Wood, who was my clinical clerk at the time they were in the hospital, or myself have not mesmerised one or both and carried on the investigation. We are enabled to state in the most positive manner, after the most rigorous daily observation for three years, that all the phænomena displayed are real: that the accusation of imposition is utterly false; and the report of one of them having been a performer among the Irvingites or been an Irvingite, is, like every other respecting them unfavourable to mesmerism, a pure malicious invention of an unfeeling mind.

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[a] One of the cleverest men in this country mesmerised an incredulous gentleman, who suddenly fell into the coma. He then blackened the gentleman's face and put him on a woman's cap, and placed a looking glass before him, intending to wake him in this state and thus convince him he had been asleep. But the wife feared he might be terrified into a fit; so the glass was removed, the cap taken off, his face washed, and he was awakened by transverse passes. When he was awake, he stoutly denied he had ever been asleep, and disbelieves mesmerism to this hour. The gentleman who operated had refused to accompany a distinguished friend of mine to the hospital to see my experiments, on the ground of having conceived a respect for me, though unacquainted with me, and being unwilling to have his good opinion lessened by seeing me make a fool of myself. At length he did accompany the Baronet. He was astonished, but could not believe, till, seeing one of the Okeys after the experiments hanging carelessly over the balusters, he made a pass at a distance behind her back and in such a manner that it was impossible for her to be aware of it, and he fixed her instantly, senseless and rigid. He has now mesmerised hundreds, and converted as many.

These sisters exhibit perfect specimens of double consciousness; the most remarkable perhaps on record. In their ecstatic delirium, they know nothing of what has occurred in their natural state: they know not who they are, nor their ages, nor any thing which they learnt in their healthy state: and in their natural state they are perfectly ignorant of all that has passed in their delirium. Their memory in their delirium reaches back only to the moment when each first woke from mesmeric sleep into the delirium. They would then, indeed, speak: but their minds were nearly blank: they knew nobody, nor the names, nature, nor use of any thing: they had to learn every thing afresh. For above a twelvemonth, whatever was told them they believed; and whatever name was given to them for a thing, they invariably adopted. Not knowing what the terms father and mother meant, and the elder being told that I was their father, and Mr. Wood their mother, they always considered these words applicable to us only. They were exceedingly silly, loquacious, as I have described the elder at p. 630. If one of us disappeared, the elder began to cry, and on being told the other had swallowed him, firmly believed it, and entreated the other to pull him up again; and, on his pretending to do this and the absentee suddenly showing himself, would be overpowered with joy and thank the other. Their language was peculiar. Almost every word was spoiled, and always spoiled in the same way: but spoiled by each differently: and each had a strange mode of expressing herself and of introducing certain superfluous words between words and syllables. For example, for opportunity, one said oppor*way*tuny*whats*ty. Mr. Wood was always Mr. Waywood. Occasionally the disfigurement of language would be much worse for a week or two.

This state has gradually improved; so that, though at this moment, while in it, they know nothing of their natural mode of existence, they are comparatively sane; they have learnt afresh to read, write, work, &c. in this state; and behave extremely well, and speak nearly like other people, talk very little nonsense, and are only rather odd. Whenever they have been brought out of this state, during now three years, they, on coming into their natural state, lose all the intermediate period, and connect the present moment with the last of their natural state, when they were thrown asleep. *Vice versâ*, when, by being sent into mesmeric sleep in their natural state, they wake up into the delirium, the present moment is continuous with the last of their former delirium. I have allowed the interval to be days, weeks, months, and never once have I witnessed a shadow of inconsistency, never once have they betrayed in one state a trace of knowledge obtained in the other state or of any thing connected with it, or a trace of the character of the other state. I have had them in my own house four months together: they were in the housekeeper's room, and watched by as sharp persons as are to be found, all day, and on occasions when they could not have believed any one near. They lived three months with a Colonel's lady. They have passed days and days with a very shrewd woman, — Mrs. Trollope. But never has there been a shadow of inconsistency or want of due keeping. Their cases, however similar, differ greatly: even the phænomena which occur in both, and are most similar, have a modification in each.

The elder, whose case, up to the publication of my Second Part, is already detailed, is far the more susceptible; and has exhibited stranger phænomena. For a length of time, she had perfect anæsthesia in her delirium. She could hold nothing unless she saw it; nor, till she acquired the habit, could she walk without looking at her feet. She used to take red-hot coals out of the fire, and wonder, as she held them, why other people cried out and desired her to throw them down, and why her hands became blistered. A seton was put into her neck by Mr. Wood behind her, while she was chattering to me who stood before her: but she never altered a feature or a tone; and, on bringing her into her natural state, she presently in turning her head felt a soreness which made her think some one must have pinched her neck. Some persons chose to doubt the reality of her anæsthesia, and stuck pins in her, and made various experiments which they thought would hurt her; conceiving the thing impossible, as though palsy is not an undoubted symptom of nervous disease. In females with nervous affections we continually observe spasmodic and convulsive actions on the one hand, and palsy of motion on the other: sometimes such morbid sensibility that the least touch cannot be borne, and sometimes the most excruciating neuralgic dartings are experienced; and often, on the other hand, we have local loss of sensation, and sometimes a general loss of it. It would be strange if such insensibility as the elder Okey's did not occasionally occur; and the doubt of its possibility betrays great medical ignorance. Other real cases have been doubted as well as those of the poor Okeys. A case of catalepsy with this insensibility occurred in the Infirmary of Edinburgh, and was lectured upon by Dr. Duncan. He made the following remarks: — "We cannot avoid noticing, and we do so with feelings of the most unmixed disgust, an unmanly, wanton, and barbarous experiment, practised on this unfortunate patient by an individual unconnected, we are happy to add, with the department of clinical *medicine*. It will scarcely be credited, but nevertheless it is strictly true, that during a paroxysm of insensibility, the person to whom we allude, *tore with his nails, two separate pieces of skin from the hand of the patient*. She was not aware of the cruel and unwarrantable experiment at the time, but she feels its effects in the intervals, very acutely. It is satisfactory, however, to know that but one feeling of the most unequivocal reprobation pervaded teachers and pupils at this inhuman and unprofessional act." Endless experiments were made which proved the reality of the insensibility. It ceased early one morning, with the occurrence of sensation of pins and needles: and her sister, who was very romping, on banging her before she got up, wondered to find her complain, for she had borne this previously without caring for it. And when she herself got out of bed she was surprised to find the floor 'so hard,' for hitherto she had never felt the floor in walking, and could not walk without seeing where she placed her foot.

She had also a wonderful susceptibility of unpleasant feeling from the influence of persons seriously ill: a feeling of weakness, oppression, and distress; and such an effect upon her mind that she, being in her delirium, fancied an image of death wrapped in white clothes, standing by the side of the patient. The more adult the patient, and the more violent the disease, the more intense were the distressing feelings, and the taller the fancied spectre. In her natural state she has nothing of the kind: and in a third state, one of sleepwaking with her eyes open, in which she walks about and speaks gently, and sighs, and sometimes does not wink an eyelid for a whole hour, in which she is not at all delirious, she has the oppression, but not the delirious image. The moment the person dies, the sensation and the image cease. This phænomenon will occur when the individual's face is not seen by her, — as when she is walking even at some distance behind a person, whom she never saw, and whose face she cannot see. I have known it occur when the patient, a child, has been at an opposite window in my street, and looking out with other children. I have tested her accounts in every way, and know them to be correct. This peculiarity had disclosed itself many months in the hospital before I learnt it, and then she let it out to me accidentally.

A third peculiarity, not observed, except for a short time in 1838, in the younger, though a condition in one respect similar to it for many months happened to her, is, that by certain means we can throw her into the state of sleeping waking just mentioned. In this state her countenance is truly heavenly; such as enraptures painters and every one who has a feeling for painting and poetry. She accurately foretells the changes in her complaints and accurately points out the means which may be required. But there was a mixture of delirium originally in this state, for she fancied she saw a kind Negro, whom she applied to and who answered her questions.[b] But this delirious fancy has long ceased. In 1837, p.685. *suprà*, I said that, from the facts recorded by Gall and Lord Monboddo, &c., I was willing to believe that a sleepwaker may prophesy morbid changes in himself with accuracy. This fact is completely realised in the elder. Her predictions respecting the return of her epileptic fits, paroxysms of sleep for a certain number of hours, the occurrence of peculiar phænomena, nay the sudden occurrence of violent inflammatory symptoms, with intense heat, sweating, rapidity of pulse, anguish of countenance, and buffiness of the blood, have been predicted by her with the most perfect accuracy even to the hour. Possibly this has depended upon the imagination. The power of mental impressions I know to be far greater than is generally apprehended: and in mesmeric states its power is greatly augmented. Lord Bacon knew well that warts, — a very trifling and fugitive structural disease, could be charmed away, that is, removed by mental impression; and he details his own case.[c] The younger Okey had once a large raw surface on the back of her neck caused intentionally through stimulating dressings after a blister. The pain was extreme when she turned her head or moved her shoulders in the least, or when any one of her brothers or sisters touched the place, as they often did. Wishing to keep it raw, but also to prevent her sufferings, we told her in her delirium to ask a figure, which she also deliriously saw and asked questions of, how we could, in her language, "make feel not live at it." She told us to pass around it a piece of silver, first dipped in water on which we had breathed, or in which we had put our finger. We did so. She *instantly* bore any slap or pressure upon this part without knowing it: we pulled off the dry and concreted lint which had been on it for days, as she had absolutely refused to undergo the pain of dressing it, without a word, a tone, or a look, expressive of pain. It was from that moment perfectly insensible, and remained so for many months, as I know by often having pinched and pricked it without her knowledge. By the same method, for months while the idea of producing insensibility in this way was strong in her mind, I made many patches of her hands, arms, neck, and face, insensible: and in every experiment, made in every way to prevent deception, to try the sensibility of these parts and the insensibility of those, the effects were uniform. The effect of the mind over the condition of sleepwaking in the elder was always shown by the somnambulism continuing as long as she said it would. She would predict accurately how long it would last: and, if she did but say it would last a certain time, her prediction never failed. Without this, its duration was uncertain; and she often fell down asleep in the midst of it when we were anxious for its continuance. Mr. Wood thought of prolonging it to an extent desirable for our experiments by prevailing upon her as soon as it began to name its duration. When it continues long enough for her to answer our question, and in it she always speaks so slowly that frequently she falls asleep before the answer comes, it has invariably lasted the time. Frequently, by keeping her in conversation it has lasted longer: but never less: and frequently it lasts the time to a minute. We often beg her to name a definite time, as half an hour or an hour: and, if she obliges us, the prediction is sure to be fulfilled. Evidently for the same reason that, if we determine to wake at a certain hour, the impression on our mind is potent even in sleep to accomplish the result: and, though unconscious of impression, we wake punctually. As to foretelling matters not relating to changes in their own systems, I have never yet witnessed any thing that gives a shadow of probability to such prescience. Persons in a mesmeric state of delirium or sleepwaking may fancy they have this power, and some may not fancy it but wish to appear to possess it; but, adhering to my original plan of asserting nothing that I have not myself witnessed and tested, I cannot defend this.

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[b] See similar phænomena in Dr. D'Espines, *Observations de Médecine Pratique, Anneci*, 1838.

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[c] *Of the Advancement of Learning.*

Cases, independent of mesmerism, in children and youth, of attacks of an infantile state, during which the thoughts, actions, and language were the same as those of the individual when a very young child, have been now related to me by medical men; and one I have seen myself, the patient,—a little girl about eight years of age, knowing nothing afterwards of what had occurred. Paroxysms of this sort, in which the language and every thing else are as they were in the delirium two years ago, attack the elder Okey, for part of an hour, if she is much mesmerised.

Many persons in the mesmeric coma will at length answer if repeatedly spoken to: some will walk; some do various things: in fact become sleepwakers. A young gentleman from Wales, who was prevented by epilepsy from following his profession, but never had a fit after he was once mesmerised, and by daily mesmerisation for a time by Mr. Symes of Hill Street has now been perfectly well for two years and is married, was easily brought out of his coma into sleepwaking by gently blowing in his face. In this state his eyes converged and his face flushed: he denied having any thing which any question implied; made a strange noise; assumed every attitude of his mesmeriser; and did whatever his mesmeriser did, and followed him every where, pushing against him, and endeavouring to get into the same point of space, so that he constantly pushed on. An excellent young woman whom I cured of a long and dreadful hiccup by mesmerism, after all other means had failed, clenched her hands and became perfectly rigid when mesmerised, except that, though her eyes were perfectly closed, I could draw any part of her in any direction, and she constantly turned towards me and assumed every position in which I placed myself. She had no power of moving her feet, so that to bend to one side or the other, to turn her body round, and to stoop, in imitation of myself, the rest of her body and lower extremities becoming situated so awkwardly in relation to her feet, and to remain thus bent round, stooping, and inclining far to one side as long as I thought proper, was what a number of strong and unprejudiced men declared with truth was absolutely impossible to themselves. And yet I have kept her thus strangely situated, and without the least support, for above an hour; and at the end of the time on waking her, which was the work of a few moments, she not only knew nothing that had occurred, but, so far from being fatigued, always felt and looked greatly refreshed.

I witnessed a remarkable cure of violent periodical insanity by mesmerism. A young man had every evening, for two or three weeks, been attacked with the most violent insanity, which lasted many hours. Several straps were required across his bed, and, in addition to these, three persons, to restrain him. His howlings always alarmed the neighbourhood: after a time he had a stage of whistling; and an uniform series of changes was always gone through before the sleep came on in which the fit always ended. Strong doses of strong medicines, and various means had completely failed. I was called in and saw him during his paroxysm: I mesmerised him for three quarters of an hour in vain, and he made many attempts to bite me. I requested Mr. Chandler of Rotherhithe to mesmerise him the following and every night before the fit begun. This gentleman was so obliging as to accede to my request; and perfectly cured his patient, who at first laughed at such a mode of treatment, and declared that he had experienced nothing, though on the first night that Mr. Chandler mesmerised him the fit was entirely prevented: and in a few nights the mesmeric process presently brought on sleep from which he quickly awoke into the fit, and the fit became shorter and shorter and milder and milder. By mesmerising him still, after the commencement of the fit, sleep again came on, from which he was awakened, by transverse passes, into his healthy state. By inducing the mesmeric sleep, the fit could be brought on at pleasure in the day: and as it was more inconvenient in the evening, Mr. Chandler always brought it on early in the afternoon, and by mesmerising him always in the fit, this was put an end to sooner and sooner, till at length it was arrested instantly and then ceased to return. The cure was effected in a very short time. At the end of a year, through a fall, the disease returned, but was cured by mesmerism very quickly.

Some are not rendered insensible, but become completely unable to command their muscles, and incline towards their mesmeriser or imitate him, being wide awake, and perhaps are painfully drawn; or are strangely agitated. In the Okeys, the susceptibility of traction of different parts was often extreme. When they were not aware of it, we have by movements of the hand behind their backs at the distance of many yards, drawn their limbs or body just as we wished. We have tied heavy weights of above 80lbs. to their arms, such as they could not lift of themselves, and in the same way drawn their arms and the appended weights up into the air. Whether they were in coma or wide awake in delirium, the result was equal. If they were once stupified, or half stupified, they often slowly put themselves into every position we assumed. Nay, when the susceptibility was extreme, whatever we did behind the back of the elder, and whatever feature of our own we contorted, and in whatever way, the same thing occurred precisely in her, though her eyes were shut. When she has been placed supine on the ground, we have drawn her right up from it in a way that in the natural state would be impossible. The young woman just mentioned, too, would rise out of the most constrained posture unassisted by any thing but the movement of my hand at a distance, in a way for which she had no sufficient muscular force in her ordinary state. We could thus place the different limbs of the elder Okey in all sorts of strange positions, and open her mouth and eyes, all remaining fixed, and thus give her the strangest appearance.

By pointing the fingers towards a part thus brought into a fixed position, the contraction suddenly at length gave way; or if we darted them towards it, the contraction always at once yielded somewhat, and, yielding every dart, at length ceased altogether.

Whatever muscular action existed, or whatever mental action was going on, with a degree of coma, deeper sleep was apt to come on, and the mind then suddenly ceased to give any sign of action and every voluntary muscle relaxed completely, except as regarded the function of respiration. Presently the sleep was at an end, and they woke with the previous delirium. We at one time could draw either sister, not only at very great distances, but where a moderately thick wooden partition intervened. We could produce the coma through screens of pasteboard, or thin wood or glass. The ordinary way of mesmerising was by passes at a short distance, or by continuing to point the fingers near the patient, whether before or behind: but contact by means of the hand upon their hands or head, or I suppose any where else, had the same effect. We always found, while the susceptibility remained equal, that the greater the surface brought into contact, or, if there was no contact, the greater the proximity; if passes were made, the more rapidly they were made; the larger the mass or surface with which the pass was made, as with both hands and not one, with all the fingers and the thumb and not the fingers only, with two fingers and not one; the larger the mass or surface with which a given part, as the hand or finger, making the pass, was connected, as when, the hand being used, I put myself in contact with a second person, or still more if we made a chain of three, and so on; the larger the individual mesmerising; the stronger he was, — the greater the effect. The points of the body, as the ends of the finger or nose, seem to have more power than any other of equal dimensions and equally covered with skin in affecting, and to be more susceptible of receiving and conveying the influence, than other parts.

The mucous membranes received and communicated the influence far more than the skin. These observations of mine Mr. Wood verified in an idiot baby, whom he has mesmerised for at least half an hour daily for eight months with extraordinary benefit. He employs passes, and the child soon goes to sleep; but, when it is asleep, it begins to breathe heavily or snore, if he puts his finger on its nose or lip. The most susceptible mucous membrane is the conjunctiva; a touch of it often causes sudden coma when other modes have failed. Consistently with all this, the point of the finger upon the closed eyelid has great effect; the eyelid being only a fine screen to the eyes: as well as the point of the finger held near the open eye. When we make passes before the eye, the wider the eye is open, that is, the greater its surface of exposure, the greater the effect. Were the effect to arise merely because the patient sees the pass made, there would be no difference whether the eye was only as open as usual, or opened as widely as possible. The region of the cornea, too, is far more susceptible than other portions of the ball. I have made thousands of the most delicate and unexceptionable experiments upon all these points, and ascertained the facts to the greatest nicety.

Many things that another person, or, indeed, I may say, another animal, has touched, acquire the influence. Thus, gold, silver, nickel, platinum, if held in the hand or mouth, will, though wiped, on being brought into contact with them, when they are susceptible, occasion sudden sleep if the susceptibility is extreme; in which sleep there may be convulsive actions; or a spasm of the part, and at length sleep; or a spasm only. Just as in the case of passes, when the susceptibility is extreme, a pass knocks them down senseless and relaxed; if they are not so susceptible, it merely stupifies them, makes them senseless, with their eyes open, rigid throughout, and fixed in the very attitude in which they were at the moment. This fixing with the eyes wide open, and senseless, is one of the most wonderful and magical-looking phænomena of the whole. Its success behind their back, and by perfect strangers, has converted hundreds who, not understanding the subject, were bewildered by the more delicate phænomena. A beautiful experiment showed the gradual diminution of the power imparted to the gold: and could, for the most part, be made upon the younger only, as her susceptibility was, in general, not so great as to show powerful effects from moderate causes. A sovereign is held in a person's hand, and then given her. Instantly her hand closes violently upon it, she becomes stupified with her eyes open, and at last falls senseless and relaxed: on waking, in a minute or two, she is desired to pick up the sovereign, and again it causes her hand to close, and stupifies her; yet not so soon but that she has time to rise a little from the floor, before the stupefaction and rigidity come; and the perfect sleep and relaxation are longer in supervening. On waking she is desired to pick up the sovereign again; the effects are longer in supervening, so that she rises higher from the floor before they come, and there is time, by pointing one's finger at her close hand, to cause it to relax, and drop the sovereign; and in consequence of the absence of this, the rigidity and stupefaction are not kept up, and terminate in waking instead of perfect sleep and relaxation. She is desired again to pick up the sovereign; she does so, and rises higher than ever before the effects come, and they are shorter. All is repeated, she rises completely before they come, and they are still shorter. Again all is repeated, and she not only rises but goes about, and talks before the effects come, and they are slight. On repetition a still longer time intervenes, and still slighter are the effects; and so experiment after experiment goes on till the sovereign has lost its power altogether. The sovereign often rolls far away; and in such cases it has been changed for one charged by contact with another person, it being impossible for her to observe the change and impossible for her to detect any difference in regard to warmth or moisture, as the original sovereign has been as much in her own hand as the new sovereign in the hand of another person. The new sovereign has always produced a far more quick and strong effect than the exhausted one.

By means of chargeable metals, I devised a mode of showing very accurately the influence of health upon the mesmerising power. I took one of the sisters into a female ward in which she had never been, and respecting the inmates of which she and I were perfectly ignorant. Every ticket with the name of the disease on the head of the bed was removed: every patient had the clothes drawn completely over her. A sovereign, which had lain long untouched, and had therefore no mesmeric charge, was taken up by her, and we proceeded to the ward. She put the sovereign under the bedclothes into the hand of each patient in succession, and at the same number of moments by my stop-watch took it out again and kept it in her hand. I noted the period in which the effect began, the length of time it lasted, and the amount of it, — whether it caused spasm of the hand only; of the hand and arm; or spasm and stupefaction. So we went round the ward, and in one bed, at the request of a certain student, I repeated the experiment. As soon as each experiment was finished, the bed-clothes were turned down and the ticket examined. The effects were in every instance precisely proportionate to the strength of the patient in whose hand the sovereign had been placed. Those in consumption or worn down with paralysis produced little or no effect:

those who had complaints not impairing the health and strength produced full effect: and all the intermediate degrees were exquisitely proportionate to the condition of the patient. One patient had produced a great effect, who, the student said, was continually bled and kept constantly on low diet. But I found she had not been bled for some weeks, had been for some time on full diet, was taking bark, looked in capital condition, and had only some cutaneous disease not interfering with her strength. Of the two experiments made at one bed, the first had produced a full effect proportionate to the strength of the patient. The second experiment produced only a moderate effect: the clothes were then turned down, and it proved that a nurse said to be in good health, and to do all the work of the ward, had been lain in it. The woman, however, looked very sickly, and I found that she had just lain in, and had come back to her place very weak, and long before she was competent. The experiment was triumphant, and an apology was the next day made to me by the student who had so misrepresented to me the state of those two patients, and at whose request I had willingly made the experiments in this his wise uncle's ward, because the results in the case of both sisters, perfectly accordant in every instance up to that time with the strength of each patient, though modified like all results in their form in each sister, had been made in my own ward, where they and I knew every patient.

Another beautiful set of experiments was made with brutes. If their hand was brought into contact with a brute, the rapidity and intensity of the effect was always proportionate to the size of the animal. If their fingers were placed under the wing of a perroquet, the effect was much inferior to what it was if they were placed under the wings of a cockatoo. If placed on the nose of a small deer, the effect was inferior to what it was if placed upon a lama or a large deer: — a mere rigidity and concussion of the head in the first instance, stupefaction and at last perfect insensibility and relaxation in the latter. Contact of the ends of the fingers with the dry rough trunk of the elephant had no effect upon the elder: but, the instant she touched the soft moist mucous membrane of the trunk of this immense beast, she dropt senseless and snored loudly, and did not become sensible for ten minutes.

Screens lessen the effects. The thicker any given one is, the greater the impediment. But the effects through them, when so managed as to prevent the patient from knowing what is doing, are very satisfactory. Mesmerised gold or silver produces its effects more slowly and faintly in proportion as it is more wrapped up: and is thus proved to have power, because, if wrapped up and rubbed against the patient, it is impossible for her to know what metal is used.

Through glass the patient sees the pass made, yet the effect is always slower and weaker than if no glass is interposed. If I blow upon the back of the neck of either sister, when very susceptible, stupefaction and rigidity are instantaneous: if into the hair of the back of the head, a few moments intervene: if there is a handkerchief or tippet on the back of the neck, and I blow upon it, many moments intervene before the effect ensues. The effects of breathing are proportioned to the distance. If standing down stairs I blow upwards towards the face of the younger, whilst hanging her head over the balusters at the very top of the staircase, the effect comes so slowly that she laughs and talks some time before she is suddenly and unexpectedly stupified and rigid.

Some metals, as lead and copper, could never be charged so as to affect the elder: and nickel had always a tremendous influence over her, such as I defy any human being to imitate. But lead and copper affected the younger, if, after having been held in the hand of another, the perspiration was not wiped off them. If it was wiped away, no effect ever occurred. Iron could never be made to affect either, under any circumstances; on the contrary, it invariably destroyed the power in charged gold or silver. Nothing could be more interesting than to see a charged sovereign or shilling lying in their hand, a skreen being held between it and their head; and, as soon as the hand began to close and the eyes to fix, to observe these effects instantly arrested and subside when a short iron rod was brought into contact with the metal, and augment again when it was withdrawn. I have often substituted a rod of silver or of some other metal, for I had rods made of various metals precisely similar in form and size, when it was impossible the girl could know which was being used; and in the case of a leaden rod I myself should not have known by the eye at the moment, but to prevent confusion had put each into a separate pocket. The silver, copper, and lead had no neutralizing power, and therefore never diminished or arrested the effect. I recollect one day having put a charged sovereign into the hand of the younger. Her hand began to contract, and she could not by any effort open it. She was very cross, and, seeing two rods exactly alike, took up one, thinking it was iron: and told me now she was a match for me and would open her hand. But her hand would not open. I then went to look at the other rod, and found that it was the iron rod, and that she had taken the leaden. I pulled the leaden one out, and introduced the iron one between her fingers and palm, and her hand immediately opened.

Friction has no power alone, but, if a part first touched or breathed upon by another person, or touched with any thing as far as I have hitherto inquired, except iron, which has the breath or perspiration or saliva of another person upon it, or with gold, silver, or nickel which has been influenced by another person's contact, though wiped, is well rubbed with an indifferent and uncharged substance, even with iron, the friction augments the effect of the previous cause; it will re-excite the effects for a long time after they have ceased; and, when they have not begun, and may be thought not likely ever to take place, will excite them. Even contact has far more effect if united with friction. Thus the point of the finger on the nose will produce an effect much sooner if it is rubbed upon the nose, instead of being held still.

Another curious fact is that, although lead and copper have no power of producing spasms of the hand, however long they may have been in contact with another person, and however long and with whatever friction they are applied; yet, if rubbed against charged gold, silver, or nickel, they acquire a charge, and, when applied, produce the effects, in a less degree, of the metal with which they have been in contact. I have made such experiments many thousand times: and allowed others to make them: and, when the susceptibility existed, the effects have been invariable. I have taken a short rod of copper or lead in my right hand, put both my hands behind me under my coat, and even had a large pasteboard placed at the same time before the face of the girl with its lower edge close against her chest, and then rubbed it five hundred times (first wiped if the subject was the younger sister) on the palm of either of them. No effect ever ensued. I have then put its extremity against a sovereign or shilling which I had in my left hand, still behind me and under my coat, and, soon after rubbing her palm with it, the hand has closed with strong spasms. I have put the rod of lead or iron behind me in different experiments again and again without bringing it in contact with the gold or silver, and never saw an effect; but after I had silently, and without the possibility of any one knowing what I did, rubbed it against the gold or silver, friction of the palm with it invariably, when there was any susceptibility to gold or silver at all, excited spasm. The mesmeric influence is capable of reflexion from mirrors, and appears to be subject to the same laws as light in this respect.

Water has no effect: but, if it is breathed into or has a finger placed in it, acquires the power of producing sudden sleep if drunk by either sister: and, in the elder, contraction of a finger or limb which is moistened with it, as well as deep sleep. We send her to sleep by passes, and measures are taken to prevent the possibility of sight, and, when she is asleep, we moisten any finger, the side of the nose, or any other part of the face with it or with plain water. If with plain water, there is no effect: if with the mesmerised, the part after a time contracts. If the back of the finger is moistened, the finger extends: if the inside, it bends: if the forehead, this wrinkles and moves up and down: if the eyelids, they open: if the angle of the mouth, it twitches sidewise. These experiments have been made thousands of times, and *always*, unless for some evident reason, with the same results. But the mesmerised water has a powerful narcotic and depressing property. The longer it is applied, and the more of it is used, the deeper the sleep and snoring become: and, if too much is used, paleness, exhaustion, rapidity and extreme smallness of pulse take place, so that no one should presume to make these experiments unless well acquainted with the subject. Indeed, with respect to any of these experiments, for an ignorant man to take the matter in hand himself, as though he had made himself master of the subject, is as absurd and disgusting as if a countryman should push aside a chemical lecturer, and mix acids, alkalies, and salts from various bottles, and declare, because things did not happen as he expected, that chemistry was fudge: or if such a clown, who had never seen a microscope before, should put objects under it, and knowing nothing about the instrument, be able to see fog and confusion only, and therefore declare the instrument an imposition. If the susceptibility is not strong, water swallowed may have no effect till a second draught is taken, or even a draught of unmesmerised water, so as to occasion friction of the part wet with the mesmerised water. Since, if a part has been breathed upon or touched by another, or touched with something mesmerised, friction with any unmesmerised or unmesmerisable substance will bring out the effects of the previous and hitherto dormant cause or re-excite effects that had ceased; should a finger be held by another person, and then rubbed with a brush moistened with unmesmerised water, effects will ensue just as if water first mesmerised were used. Should mesmerised gold or nickel have been applied to a part, and from the susceptibility being low no effect have occurred, or should there have been an effect and it have ceased, friction with any thing will bring out the effect of the thing previously applied: or should a thing not directly mesmerisable, but mesmerisable by contact with a directly mesmerisable metal, be ignorantly allowed to be in contact with a mesmerisable metal, and then be applied to the person, the effects of the directly mesmerisable metal will be produced.

Great care is requisite to prevent other causes of mesmerism from acting. If, while some unmesmerised or unmesmerisable substance is applied and the susceptibility is great, a person makes a pass near or at a distance, or breathes upon the patient, or though at some distance breathes towards her, or if any contact of hand, whether with the hands or even a covered part as the shoulder, take place; or should a person look intently even behind the patient, especially should several do this[d]; or should one or more remain very near her, sleep may come on, though not any local effect such as mesmerised metals or water induce. For example, at times the susceptibility has been such that a person had only to fix his eye upon either sister, behind her back, when she could not possibly know it, and she was stupefied and fixed or dropped senseless and relaxed. Indeed, it often happens when a person has been rendered susceptible by mesmerising, but not before, that the imagination will alone induce sleep. When placed quietly, and led to expect they are being mesmerised, they will gradually fall asleep. But this no more upsets the variously made other experiments, than the sleep of a person accustomed to an opiate pill, or the evacuation of the bowels of a person accustomed to a cathartic, though a pill of crumb of bread be substituted without his knowledge, proves that neither opium nor colocynth has medicinal properties: nor because the mere sight of a steamer will cause sickness in those who have been sea-sick, that a ship's motion has no such effect.

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[d] I have frequently mesmerised one sovereign among many with my eye, looking intently at it while the girl was out of the room; and, on her taking up this one, the hand has been cramped, though no other had this effect; but another would have this effect afterwards, or, to speak correctly, mere voluntary closure of the hand, which implies so much friction, would have this effect.

It is also to be remembered that the susceptibility fluctuates; that it will be high or low for days, and may vary in the same day. As soon as it is found to vary, the particular experiments in which we are engaged should be desisted from. A moderate number of experiments increases the susceptibility, but many exhaust it. Those with passes only, and by traction, scarcely exhaust; but those with metals and water very soon take off the susceptibility, and derange and debilitate the system. And this is not by tiring the patient; because mere mesmerism, by passes of the hand fixing and stupefying them all day, rather refreshes than tires, and because, when the susceptibility to passes has declined, it may be at once augmented again by operating two or three times with gold. From some modification of the power by the metal or water, after strong or continued results from either, there frequently is no susceptibility at all; and, after this absence of susceptibility, every now and then, the system beginning to recover itself, an experiment succeeds. But, if experiments are repeated thus early, the susceptibility is again exhausted presently, and effects no longer result till it has accumulated again. An early experiment soon exhausts it again; and thus an ignorant person, determined to make experiments at all hazards, as though he had inanimate matter before him, is confounded, and, if conceited and overbearing, presumes to pronounce all an imposition. When these points are remembered, as well as the fact of the different degree of susceptibility of the two sisters and the peculiarity of susceptibility in each, no wonder that strange inferences should have been drawn, and much nonsense written against palpable truth.[e]

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[e] As much of the subject was new, and required very careful investigation, I refrained from publishing my results; but, to prevent all objection and malignity, I made every experiment with open doors, and gave every body all the facilities of observation in my power. Although the results of the experiments were real, and without deception in the eyes of every person capable of observation (and fewer can observe well than reason), exceptions, difficulties, and failures, con-

Why some are susceptible and others not, is no more known than why some are never salivated with mercury and others salivated by a single grain of calomel; why some have never been

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stantly occurred, as in every laborious investigation. By perseverance I have now ascertained the cause of every difficulty and failure.

In my address to the students on declining to hold my professorship any longer at University College, (which address may be procured at Longman's, and is published in the *Medical Gazette*,) was the following passage: —

" In an evil hour I consented to show some experiments to the Editor of the *Lancet*, after repeated entreaties conveyed by his assistant, Mr. Mills, who had witnessed the phenomena at the hospital, reported many in the *Lancet*, been enraptured with them, and declared them over and over again to be so satisfactory that to doubt or to suspect the two Okeys of imposition would be the height of absurdity. I exhibited to the Editor the production of the singular delirium, and a variety of the most beautiful and satisfactory experiments which he has entirely suppressed. But I presently feared what would be the result. He said he was pestered with letters upon the subject; but that nineteen out of twenty were unfavourable. Nineteen persons of course purchase more *Lancets* than one, and I fancied I already saw his rejection of the evidence. The mental phenomena were such as no person capable of sound and refined observation, and fitted for philosophical investigation, could for an instant have imagined to be feigned. The physical phenomena with the hand, the eye, metals, and water, were as striking and conclusive, with the exception of some with lead and nickel; and those I have since proved to large numbers of able judges to be equally conclusive. Mesmerised nickel produces upon the elder sister the most violent effects, which none but a very ignorant person could consider pretended. Now when this, or gold or silver, has been rubbed upon a part, and the friction has been desisted from before the effects come, or the effects have come and have ceased, they may be at once excited in the former case, or re-excited in the latter, by friction of the part with any thing — a piece of wood or a piece of lead; and this excitement may be produced again and again. Friction was performed with lead upon parts to which nickel had been applied, either with or without effect as it might be, and the effects took place violently. This explanation I gave to the Editor, but he was either too dull to understand, or had his reasons for not understanding. In another set of experiments lead produced effects, though nickel had not been applied to the parts; and yet I never had been able to mesmerise lead by holding it in my hand and to produce effects by then applying it. Those effects I candidly said I could not explain, since I had not commenced experiments with lead or nickel for more than two or three days: but, as there was no more deception in the cases, nor less certainty of the various facts which I had observed, than in chemistry or any other natural science, I added that these results showed only that they required farther investigation, and that I had no doubt I should, by perseverance, discover their cause. The Editor knew that I was about to leave London that same day for sea-sick, while others are sick almost unto death as soon as they are at sea, or by only looking at a steam-packet after having been sea-sick; or why people change in these as well as so many other particulars at various times.

I have mentioned my persuasion that persons in a mesmeric state may predict, without any guess, the changes in their own disease and general health; but no more. Whether, by touching others, they, through some instinctive feeling, can learn the state of the system in a way that others cannot, I will not venture to determine. A Parisian sleepwaker, who had never seen us, certainly told the state of health of a friend and myself accurately

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an absence of six weeks on the continent, and yet he could not wait for my return and give me an opportunity of farther research, but, with that gentlemanly delicacy for which he and his friends are so remarkable, published, almost immediately, what professed to be an account of what he had seen, — a most imperfect and worthless account, however; in his plenitude of scientific importance, he declared that not one more experiment on magnetism would ever be required; and answers which were sent he never published. He omitted to state a circumstance in his experiments with lead, which had never been allowed to happen in mine, but which, when reflecting upon them on my tour, I thought might have influenced the results. In employing the lead, I had noticed that he applied it against a piece of nickel held in his other hand, before he applied it to the patient. On my return, I applied lead to her as before, and indeed, copper also; yet never obtained an effect. I then applied the lead or the copper, as it might be, against a piece of mesmerised nickel or gold, before applying it to her, and its application to her was always productive of effects. I discovered that the surface of the lead or copper had become nickelised or aurified by the contact; and thus the difficulty was solved. These experiments I have repeated again and again before numbers of gentlemen, taking the greatest care that the patient should not know when I applied lead or copper which had not been in contact with either of them, and the results have been uniform. I was obliged to leave the poor little girl in an intense coma, with occasional violent tetanic spasms, at the Editor's house, little imagining that any farther experiments would be attempted, especially in my absence, by a person ignorant of the subject and altogether incapable of making experiments. I had seen sufficient of the extreme carelessness, and want of information and philosophic power of the Editor, during the experiments conducted by myself, and which he frequently altogether deranged, not to be convinced that in my absence no experiment could be made in a manner to justify conclusions. In his ignorance, he acted as though mesmeric susceptibility is always present and always the same: whereas the reverse is the fact; and experiments with water and metals frequently repeated so derange the susceptibility, that we are often obliged to desist."

to the minutest point. But very many such instances would be necessary to prove that all was nothing more than a successful guess: though, as I can conceive the possibility of endless external senses, I can conceive the possibility of many susceptibilities and faculties; the brute creation have many which we have not.

Upon transposition of the senses, as it is called, I have no facts of my own. The elder Okey has an appearance of fits of seeing with the back of the hand; and both she and her sister have had an appearance of hearing for a short time, the one with the shoulder, the other with the hand. There was no attempt at deception. In the natural state they would be greatly hurt at the mention of their having appeared to exhibit such phænomena, and in their ordinary delirium they laugh at it as nonsense.

It might be a delirious fancy, or a faint degree of the transposition of the senses; but I cannot prove the reality of the thing, so imperfect have been the signs of it in every instance.

There appears to me no reason why one part of the nervous system should not, in a new and strange state, acquire properties foreign to it and possessed by another analogous part of the same system. I do not believe that the liver, or even the sciatic nerve, could, in any state, think; nor even that a nerve of mere motion could perform the part of one of sense. But I see no reason why a nerve of one feeling should not acquire another feeling. The nutrient vessels of one organ will deposit, in disease, what is foreign to their natural function:—arteries will ossify, and muscles be replaced by fat. One secreting organ in preternatural states will secrete what nature never intended it should: even a case is well attested of secretion of genuine milk by the scrotum of a young man twenty-one years of age.[f] I therefore know no reason why one nerve of sense should not be able to perform the office of another. In truth there is now the evidence of my fellow-labourer to the fact.

> " Le vrai n'est pas toujours vraisemblable."
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> FONTENELLE.
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> " I never said it was probable: I only said it was true."
>
> MONK LEWIS.

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[f] *Gazette Médicale de Paris*, 4 Juillet, 1825; also an analogous case in *Hufeland's Journal*, vol. liv. See *Lancet*, vol. xxviii. pp. 465. 597.

In 1828 I went to Paris to witness, through an introduction, what was declared to be an instance of this kind, and has been the subject of much controversy. The friend who accompanied me, and believes in mesmerism as firmly as myself, was, like myself, thoroughly disgusted.

The Rev. Mr. Townshend, in his recent work[g], describes some instances of it; and that of the young man at Antwerp is very staggering. Mr. Wood was lately in Paris, and visited a man who was said to see without his eyes, and also to have a knowledge of distant places to which he had never been; and of distant occurrences: but was as much disgusted as I had been with the young lady two years ago. He afterwards went to Antwerp, to meet Mr. Townshend and the young man just alluded to. Now I can place the utmost confidence in Mr. Wood. Though he has resolution to disregard all ignorance and clamour and to adhere firmly to truth, he is any thing but disposed to give way to the tales of mesmerisers; he examines every thing in the most pains-taking and dispassionate manner; and, like me, knows many occurrences to have been absolute deceptions, which others have pronounced realities. I can place the same reliance upon his honour as upon the coolness and force of his judgment. I will lay before my readers extracts from two letters which I received last month, though they were written with no thought of publication.

"Paris, Hôtel des Etrangers,
Aug. 13. 1840.

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"In the first place, having found out B., I went with him to see the case of *clair-voyance*, which he spoke of when in London. I have so little time that I cannot describe the particulars of what took place, beyond his having some cotton placed on his eyes, and a handkerchief tied loosely over them; at least it appeared to me so loose as to admit the possibility of his seeing down in this way. He contrived to tell a few words, such as the titles of books, which were in large characters, and also a few words which were printed with a pen. I suggested the possibility of his seeing down, — it was declared impossible, and he himself was very anxious to convince me that he derived no assistance from his eyes, and for this purpose threw his head back, and desired me to examine the position of the bandage and pads. This was rather a curious thing for a somnambulist to do; another not less so was that, professing, as he did, to see with the epigastrium, he should have placed himself close to the table, and crossed his arms directly before this seat of his new sense; so that, if indeed it existed, he took the most effectual means of impeding it or rendering it useless. On this occasion there were several persons present, students of the Polytechnic School, &c.; and, as the evidence was not conclusive, it was arranged that we should see him alone the following day, when I was to bandage the eyes myself and take any other precaution I thought necessary. Accordingly, we arrived at the appointed hour, and after he had been thrown into his usual state, I began my part of the play. I was about to put some solid substance, as coins, inside the cotton, but that was not permitted — it would interfere. I then applied for a larger allowance of cotton, and, having pretty effectually closed his eyes with it, proceeded to apply the bandage; but, when I attempted to tighten it, he called out that I was about to smother him and that I hurt his eyes. In short, he would not allow it to be effectually applied. I then gave it up, declining to operate, and left B. to apply it; and then put another bit of cotton on each side of his nose, at the same time declaring that I did not believe that his eyes were sufficiently closed, and proposed to do away with all bandages, and simply hold a large book, or something of that sort, under his chin. This he would not agree to at all. With the bandage thus applied, as he was evidently determined to suffer no other impediment, he contrived, as before, to tell a few words, and to play at *écarté*, now and then saying what cards I held, principally by guess, and partly by seeing something of them. After this he agreed to accompany B. in a '*voyage mentale*' to London. The locality fixed on was your house, and of all the absurdities we had hitherto witnessed this altogether distanced them. He professed to describe the house, the entrance, the hall, stairs, &c. This description would have done as well for Buckingham Palace or any house in one of the small streets of London. I almost dread seeing Mr. Townshend's case after this, lest I should find that he also has been grievously deceived."

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[g] *Facts in Mesmerism, with Reasons for a Dispassionate Inquiry into it.* By the Rev. Chauncy Hare Townshend, A.M. 1840. I would praise it as it deserves, were it not dedicated to me.

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In less than a week I received the following:—

"Antwerp, Hôtel du Grand Laboureur,
Aug. 18. 1840.

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"I cannot allow this day's post to leave without sending you a few words, to say that within the last half hour we have had undeniable proof of the existence of *clair-voyance.* I am compelled to renounce my incredulity on the subject; and can assure you I do not do so without having satisfied myself beyond the possibility of further doubt. I had scarcely dared to hope for such success, after the very imperfect exhibition at Paris. The patient E. A., mentioned in Mr. Townshend's book, arrived here this morning. Mr. T. mesmerised him, and, having thrown him into his usual state of sleepwaking, proceeded to bandage his eyes. In this state he astonished me by the invariable correctness with which he told cards, &c.; but, what was much more decisive, he was able to do the same when Mr. T. closed his eyes with his fingers. The bandage being removed, he now told cards and *read* out of a French book that I fetched out of my own room. I asked and obtained permission to apply my own fingers to his eyes, and, having done this in the most effectual manner, was astonished to see him read correctly a whole line at a time out of my French book of 300 pages at least and opened repeatedly and at different parts: he did the same when my brother closed his eyes in the same manner. I am *quite certain* that he could not by possibility see with his eyes; and the frequency of the experiments completely did away with any thing like chance or accident in his mentioning words, to say nothing of the number which he repeated at a time, and this several times over."

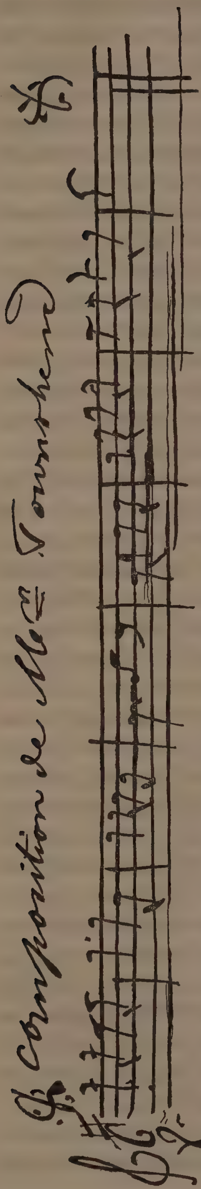
On his return to town Mr. Wood has been kind enough to write me out the following detail of all that he witnessed.

August 18th.—The patient described in Mr. Townshend's work on Mesmerism by his initials E. A. was this day mesmerised again by Mr. T., for the first time after an interval of nearly two years.

E. A. is a native of Belgium, about 18 years of age, of rather small figure, but robust, of very healthy appearance, with a very intelligent countenance.

Notwithstanding his prepossessing appearance, and the high terms in which he was spoken of by my friend Mr. Townshend, together with an account of the extreme caution that had been used in closing his eyes during his mesmeric state, I confess I could not bring myself to believe that the being before me was capable of exhibiting the extraordinary phænomena, the astounding facts, I was invited to witness, of seeing without the use of his eyes. Not that I for a moment doubted the perfect good faith and sincerity of the operator; on the contrary, I had every reason to be satisfied that his sole object was the establishment of truth; but I was willing to believe that he had, notwithstanding all his precautions, been deceived,—that the closing of the eyes had not been so effectual as he imagined—in short, any thing rather than the possibility of *clair-voyance*.

The patient being seated, Mr. T. placed himself immediately in front of him, also sitting, at the same time holding his hands and looking him steadily in the face. After continuing in this position about ten minutes he became drowsy, having evidently great difficulty in keeping his eyes open: a few passes in front of his face continued downwards towards his feet completed his sleep: he did not, however, show any symptoms of falling; on the contrary, appeared to rouse himself into a new state, the eyelids remaining closed. He was very restless and apparently uneasy, but did not speak; he would, however, answer any questions put to him by Mr. T., but took no notice of any other voice, unless the person had previously been in contact with Mr. T.: he seemed to cling to his mesmeriser, and was very unwilling to leave him for a moment. He continued for a long time very fretful, and showed great reluctance at exerting himself in any way; and, when asked by Mr. T. if he could see, expressed by his manner great unwillingness to try, and said "What for?" "Mais pourquoi donc?" With a little persuasion he allowed his eyes to be bandaged and cotton to be placed by the sides of his nose, so as I believe effectually to close them and prevent his seeing any object presented; but if there had been any space left by the side of his nose which could have enabled him to see down, he made no attempt to avail himself of it, but invariably presented the card or any thing else that was given him to his forehead, and I am quite certain that he repeatedly told correctly a card, which from the time I drew it from the pack to the moment he mentioned it had never been below the level of his eyebrows. With his eyes thus bandaged, Mr. T. presented a card, at the same time asking what it was: after a little persuasion he was induced to direct his attention to it, and after holding it to his forehead, at the same time moving it about as if to get it into the proper light, he told it correctly and threw it on the table: this was repeated several times with uniform success. The bandage was now removed, and Mr. Townshend covered his eyes with the palms of his hands, the fingers being directed upwards, and so covering the greater part of his forehead: he told the cards just as well, and never once named a wrong one. Mr. T. kept his eyes closed in the same manner with the palms of his hands while I presented a French Guide-book, which I had the minute before fetched from my own room and opened at random. He presented it to his forehead, and made some remark about its being very small print: he read some word which was printed in larger letters, and then turned over the leaves at random backwards and forwards until a long table of figures attracted his attention: he said with some surprise, "O qu'est ce que c'est que cela?" and repeated several of the figures, at the same time pointing to them with his fingers, but not touching the figure that he mentioned: he continued for some time turning over the leaves, stopping at every thing remarkable, as tables, plans of towns, &c., and always describing them accurately. Mr. T. now closed his eyes by placing the ends of his fingers over the lids: he told every card that was presented to him, and read out of the book without making a single mistake. I now asked for and obtained permission to apply my own hands to his eyes, and did so in such a manner as to preclude the possibility of his seeing any thing with them. Cards were again presented to him: he told them correctly and without hesitation, without being wrong once: the book was again given him, and he read slowly, but without the least hesitation, several lines, tracing his finger along a little under each as he read. The longer the experiments were continued, the more perfect became his power of seeing, and the irritability diminished. Mr. T. now asked him to write some music. Every new effort required persuasion. He at last consented. The bandages were reapplied as carefully as before: a sheet of note paper was laid before him, with a pen and inkstand



the opening at the top of which would scarcely admit a swan's quill. He took another book as a ruler, dipped his pen without difficulty into the small inkstand, and at once proceeded to rule the music lines: about the middle of the third the pen missed; he instantly saw the deficiency, and, without carrying his pen on to the end of the line, stopped, took another dip out of the small-mouthed inkstand as easily as if his eyes had been wide open, and again placed the point of his pen exactly where it had missed, and continued the line; but, before proceeding far it again missed. He appeared to be quite aware that it was not from deficiency of ink, and, turning his pen a little, he went back to the point where he left off, and with one stroke continued it to the end. A little difficulty of the same sort occurred in the fourth line, and was equally well managed; he was not so particular about the fifth. Having completed the lines, Mr. T. whistled a part of a tune, and asked him to write it in music: he presented his forehead to the paper, and with great rapidity wrote a few notes, and then stopped to ask Mr. T. to repeat it; when he immediately resumed, and presently filled the line. Whilst in the middle of it, I suddenly placed my hand between his head and the paper: he immediately stopped, turned his forehead towards me, saying, "Qu'est ce que vous voulez donc?" and then immediately finished the line. He now begged Mr. T. to awake him, which was accordingly done by a few transverse movements of the hands in front of his face.

After an interval of two or three days, E. A. was again mesmerised: on this occasion it was at the house of a gentleman where a small party was assembled, and where E. A. had been invited to in his capacity of musician. Not being aware of the real object of his visit, he objected very strongly when it was proposed to mesmerise him, but at last consented on condition of its being done in another room with only two or three present. It was accordingly so arranged; and, after the sleep had been produced as on the former occasion, the rest of the company were admitted. His lucidity was now even greater than before. His eyes were stopped as before by bandages or by the hands of any of the company, and he told without hesitation every card that was presented, with one exception; and this was the only mistake I ever saw him make:—the Knave of Diamonds was presented: he said it was the Queen of Diamonds: but I ought here to observe, that the difference between the Knave and Queen in French cards is not nearly so well marked as in the cards used in England,—indeed, with my eyes open, I frequently mistook the one for the other. While the bandages remained on his eyes, a thin music book containing about twenty pages of music was held before his face and cards held behind it, so that his only chance of seeing them was to see through the book: he never failed to tell them correctly. I now took the pack of cards into my own hand, and, taking care that no person should see what card I took, chose the Ace of Clubs,—thinking that, if he saw through the music, this card with only one spot upon it, and that of the same colour as the notes through which he had to arrive at it, would be as puzzling as any that could be selected. To make assurance doubly sure, having previously ascertained that the bandages remained safely applied, and the same music being held before his eyes, I presented the back of the Ace of Clubs on the further side of the music book: he first turned it over with its face towards him, moved it a little backwards and forwards as if to get it into the right position, but without any attempt to get it nearer the edge of the music book, suddenly exclaimed, "Oh! il n'y a qu'un point," named the card correctly, and threw it down. A gentleman presented his closed hands to him, at the same time asking what they contained: nobody present but the gentleman himself knew that it contained a purse, but E. A. told it correctly. While his eyes were bandaged, I presented my watch to his forehead: he could not possibly have seen it with his eyes, but he told the hour to half a minute; it was between eight and nine minutes past 10 P. M., although by the Antwerp time it was not quite 10, —my watch being about ten minutes faster than the clock of the Cathedral. A large silk handkerchief was doubled three times and hung over his head so as to cover his forehead and face, the bandages still remaining on his eyes, but he still told correctly any card that was presented to his forehead. A sentence was written in French and another in English: he read them both correctly, but, from his not knowing any thing of the latter language, his pronunciation of it was rather peculiar.

21st.—I again saw E. A. mesmerised and the same experiments repeated: in addition to the precautions which had been used on former occasions, some eye-goblets made of porcelain were used. This was perhaps as effectual a method of closing his eyes as any that could be devised; but, when carefully applied over his eyes, they did not appear to offer the slightest impediment; he told all the cards as fast as they were presented, never failing to turn them when their backs were held towards him, and never once naming a wrong card. With his eyes bandaged, he read out of a French newspaper and a book which was accidentally lying on the table. I took the newspaper, turned it backwards and forwards, and folded it up so as to present only a very small portion of a column; consequently, had he known every word of the paper by heart, he could have had no idea what part was placed before him. However, without hesitation he pointed to the commencement of a sentence, and tracing his finger under the line as he went on, read several successive lines without making a single mistake. From the position in which the paper was held, I believe it would have been impossible for him to have read it with his eyes, had they been wide open at the time and free from all impediments, as bandages, &c. His eyes on this occasion were also closed by sponges held tightly against them.

25th.—E. A. was again mesmerised for the fourth and last time: the same things were repeated as on the three former occasions; there was not a single failure. He could not see so well if any thing was placed between him and the candle, and evidently preferred that the light of the candle should be made to shine on the object to which his attention was directed, particularly if it was any thing he was required to read. He told all the cards without difficulty, and at last took up the pack, and as fast as he could present them to his forehead told their names and threw them down on the table: all this time his eyes were securely bandaged. Mr. Townshend asked him if he could see a card at the back of his head: he declared he could not, and was very unwilling to try: it appeared to require a great effort; but, after a good deal of persuasion, he sat up in his chair as if to get the back of his head nearer a card which Mr. T. was holding there, and after a short interval, during which he had no opportunity of seeing with his eyes, named it correctly. He again wrote some music with the same correctness as already described on a former occasion; and, when Mr. T. asked him to play it on his flute, he took up the small case which contained it, and applied a small key to the small lock with as much precision as if his eyes had been wide open; then, having correctly adjusted the different joints, played over the music he had just written.

Mesmerism is a most useful addition to our remedial means. By it, without giving any medicine, I have several times cured epilepsy; but, as the causes of this disease, as of paralysis, are variable, and often irremediable, general success cannot be expected. A case of violent and singular jumping and striking fits of twelve years' duration, lasting six weeks spring and autumn, has yielded to it. A case of chorea was presently cured. A case of intermittent hemiplegia, recurring every few days, and leaving the poor woman in a wretched state for two or three days, has been permanently cured, after resisting all means in Essex for five years. Hysterical insanity, and palsy of the lower extremities, as well as the strangest hysterical symptoms, have yielded to it: and the most distressing hypochondriasis, obstinate hiccup, and that distressing affection termed sick-headache, have been cured with it among my patients. Like every other remedy it can be adapted to a certain number only of diseases, and can succeed in a certain number only of modifications of these.

The Marquis de Guibert has just published a tract[h], containing the results of his experiments; and assures me that he has bestowed such care upon all his experiments that the results may be implicitly relied upon. He mesmerises the poor of the country in which his château (Fontchâteau) stands.

"Result of the magnetic treatment, from January 1. 1834, to January 1. 1840:—

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[h] *Résultat des Opérations Magnétiques.* Tarascon, 1840.

"3315 patients:—1194 men, 2121 women.

"424 men became somnambulists; 663 were cured; 180 relieved; 171 did not make known the results; 180 derived no benefit.

"1279 women became somnambulists; 1285 were cured; 195 relieved; 317 did not make known the results; 324 derived no benefit.

"Of the 424 somnambulist men, 28 presented the 2d degree (mesmeric blindness)," (I presume inability to open the eyes, which is a curious effect); "157 the 3d degree (magnetic sleep); 237 the 4th degree (magnetic somnambulism); and 2 the 5th degree (magnetic ecstasy).

"Of the 1279 somnambulist women, 228 presented the 2d degree; 327 the 3d; 720 the 4th; and 4 the 5th degree."

THE END.

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